Review

Journal of Feline Medicine and Surgery
15(4) 237–265

DOI: 10.1177/1098612X12473466
jfms.com
SAGE

Mechanisms, causes, investigation and management of vomiting disorders in cats: a literature review

Daniel J Batchelor[1], Patrick Devauchelle[2], Jonathan Elliott[3], Clive M Elwood[4], Valerie Freiche[5], Massimo Gualtieri[6], Edward J Hall[7], Erik Den Hertog[8], Reto Neiger[9], Dominique Peeters[10], Xavier Roura[11], Karine Savary-Bataille[12] and Alexander J German[1]

Abstract

Vomiting is a common presenting complaint in feline practice. This article differs from previous reviews in that it is an evidence-based review of the mechanisms, causes, investigation and management of vomiting in the domestic cat. Published evidence was reviewed, and then used to make recommendations for clinical assessment, diagnosis, antiemetic drug treatment, dietary management and monitoring of cats presenting with vomiting. The strength of the evidence on which recommendations are made (and areas where evidence is lacking for cats) has been highlighted throughout.

Accepted: 11 December 2012

Introduction

Vomiting is a common presenting complaint in feline practice and occurs in an enormous range of disease processes. It is amongst the most common clinical signs reported in cats examined at private veterinary practices.[1] The aim of this study was to perform an evidence-based review of the mechanisms, causes, investigation and management of vomiting in the domestic cat. In each area recommendations have been made, and the strength of the published literature, upon which the recommendations were based, has been presented.

Methods

A systematic literature search was performed in PubMed using the search terms [('vomit*' OR 'emesis') AND ('cat' OR 'feline')] and ['antiemetic*' AND ('cat' OR 'feline')]. All articles relevant to domestic cats were collected, ignoring those dealing solely with captive large felids. Only articles relevant to actual vomiting (defined for these purposes as the forceful ejection of stomach contents via the mouth) were considered; any articles that dealt solely with nausea were not included. Similar searches were made in the Centre for Agricultural Bioscience International database (CAB direct), Google Scholar and Web of Science, identifying additional references not listed in PubMed. To indicate the strength of available evidence in support of the statements and recommendations made, references were assigned a level of evidence (LOE), and an overall evidence grade

[1]School of Veterinary Science, University of Liverpool, Liverpool, UK
[2]Centre de Cancérologie Vétérinaire, ENVA, Maison Alfort, France
[3]Department of Veterinary Basic Sciences, Royal Veterinary College, London, UK
[4]Davies Veterinary Specialists, Higham Gobion, UK
[5]Clinique Vétérinaire Alliance, Bordeaux, France
[6]Department of Veterinary Clinical Science, University of Milan, Milan, Italy
[7]School of Veterinary Sciences, University of Bristol, Langford, UK
[8]Medisch Centrum voor Dieren, Amsterdam, the Netherlands
[9]Veterinärmedizinische Fakultät, Universität Giessen, Giessen, Germany
[10]Faculté de Médecine Vétérinaire, Université de Liège, Liège Belgium
[11]Hospital Clínic Veterinari, Universitat Autònoma de Barcelona, Barcelona, Spain
[12]Pfizer Animal Health, Europe & AfME ahg, Paris, France

Corresponding author:
Alexander J German BVSc, PhD, DipECVIM-ca CertSAM, MRCVS, Department of Obesity and Endocrinology, University of Liverpool, Leahurst Campus, Chester High Road, Neston, CH60 5SZ, UK
Email: ajgerman@liv.ac.uk

Table 1 Scheme used to grade level of evidence for individual references and overall level of evidence (adapted)[2,255]

(a) Study type	Level of evidence
Systematic review (with homogeneity) of randomised controlled clinical trials (RCT)	1a
Individual RCT (with narrow confidence interval)	1b
All or none*	1c
Systematic review (with homogeneity) of cohort studies	2a
Individual cohort study (including low quality RCT, eg, <80% follow-up) or well-controlled laboratory study	2b
'Outcomes' research; ecological studies	2c
Systematic review (with homogeneity) of case-control studies	3a
Individual case-control study or weak laboratory study	3b
Case series >50 cases	4a
Case series 20–50 cases	4b
Case series <20 cases	4c
Single published case report	4d
Expert opinion without explicit critical appraisal, or based on physiology, bench research or 'first principles'	5
(b) Types of study	**Overall evidence grade**
Consistent RCT, cohort study, all or none,* decision rule validated in different populations	A
Consistent retrospective cohort, exploratory cohort, ecological study, outcomes research, good laboratory study, case-control study, or extrapolations from level A studies	B
Case series study or extrapolations from level B studies	C
Expert opinion without explicit critical appraisal, or based on physiology, bench research or first principles	D

*The all or none principle is met when all patients died before the treatment became available, but some now survive on it; or when some patients died before the treatment became available, but none now die on it

(OEG) for each aspect was also assigned (Table 1), as described previously.[2]

The emetic reflex and causes of vomiting

Vomiting in cats is a complex reflex involving the gastrointestinal system, respiratory and abdominal muscles, and changes in posture [2b[3–6]]. Some of these coordinated reflex events are a reduction in gastric motility, retrograde movement of gut contents from the proximal intestine to the stomach, and relaxation of the gastro-oesophageal junction followed by expulsion of gastric contents brought about by forceful contractions of the diaphragm and abdominal muscles, and closure of the glottis [2b[3,5–13]] [OEG B].

Vomiting may be triggered by peripheral stimuli, such as afferent neural input from the gastrointestinal tract or other visceral organs, or central stimuli, such as circulating toxins that activate the central nervous system (CNS) via the area postrema (AP) [2b[8,13,14]]. The AP is a bilateral structure adjacent to the fourth ventricle, considered to be outside the CNS because it lacks a blood–brain barrier [2b[15]]. It is a chemoreceptive area that triggers vomiting, and its ablation abolishes the emetic response to most (but not all) emetogens [2b[16–19]]. Vestibular stimuli (motion sickness) can also cause vomiting in cats, although susceptibility varies between individuals [2b[20,21]]. The AP is not involved in motion sickness [2b[22,23]]. As in other species, input from midbrain or forebrain structures also may trigger vomiting [2b[6,13]] [OEG B].

Regardless of how it is triggered, the motor act of vomiting is coordinated at the level of the brainstem by the same set of structures [2b[6]]. In cats, vomiting is coordinated by a distributed control system, not a discrete vomiting centre: neurons activated during vomiting are distributed in the brainstem in an area extending from the AP and dorsal motor nucleus of the vagus through the nucleus of the solitary tract (NTS) and lateral tegmental field of the reticular formation to the region of the retrofacial nucleus in the ventrolateral medulla [2b[18,19,24]]. This area also contains neurons controlling related functions, such as respiration, cranial nerve integration, swallowing and salivation [2b[19]]. The NTS is thought to be the beginning of a final common pathway by which different triggers produce vomiting, and receives inputs from sources that can trigger vomiting, such as the vagus nerve, the AP, and vestibular and limbic systems [2b[6,18,23,25–27]] [OEG B].

The conditions that have been reported to be associated with vomiting in cats are listed in Tables 2–4, mostly

Table 2 Alimentary tract conditions that have been associated with vomiting in cats

Disorder	Processes	Level of evidence and reference(s)	Overall evidence grade
Colonic obstruction		4c[256], 4d[257], 5[166]	C
Congenital abnormalities		4d[119]	D
Dietary	Food sensitivity	4b[28], 4c[29–32]	C
	Refeeding/enteral tube feeding	4a[217,218,258], 4b[259]	
	Dietary indiscretion	4c[33]	
Feline acute haemorrhagic vomiting syndrome	Syndrome of self-limiting acute vomiting often with fresh blood, occurring in outbreaks in rescue shelters and catteries; recently recognised in the UK, aetiology not yet known	5[260]	D
Foreign body	Linear foreign bodies	4a[37], 4b[38]	C
	Trichobezoars	4c[36]	
	Enterolithiasis	4d[261]	
Gastric entrapment	Diaphragmatic rupture	4c[262], 4d[263]	C
	Gastro-oesophageal intussusception	4d[137,138,264]	
	Gastric dilatation/volvulus	4c[265]	
	Hiatal hernia	4c[266–268], 4d[269]	
Gastritis	Acute	5[201,202]	D
	Lymphocytic-plasmacytic	4d[141]	
	Eosinophilic	4d[270]	
	Parasitic	4c[146,271,272], 4d[273]	
	Associated with spiral bacteria	4c[117,118]	
	Associated with foreign body	4c[156]	
	Gastroduodenal ulceration	4d[274]	
	Hyperplastic gastropathy		
Inflammatory bowel disease		4a[44], 4b[45–47], 4c[29,48,49]	C
Infection	Coronavirus	4c[125,274]	C
	Intestinal mural lesions caused by feline infectious peritonitis	4b[275,276]	
	Feline panleukopenia virus	4b[34], 5[122]	
	Bacterial	4a[277], 4c[278]	
	Yeasts	4d[279]	
	Ollulanus tricuspis	4c[271]	
	Other parasites	4a[123,280,281], 4c[146], 4d[224]	
Intestinal strangulation		4d[282]	D
Intussusception		4b[120,121], 4c[283]	C
Neoplasia	Gastric polyps	4d[284]	C
	Gastric neoplasia	4b[285], 4c[126,145]	
	Intestinal neoplasia	4d[143,232,233,286,287]	
		4b[142,164], 4c[128,131,165]	
		4d[144,151,157]	
Pyloric stenosis/ dysfunction		4c[129,130,288,289]	C
Small bowel infarction		4d[290,291]	D
Zollinger–Ellison syndrome		4d[236,292]	D

at LOE grade 4 or 5. Based upon these reports, the most common causes include adverse reactions to food [4b[28], 4c[29–33]], infectious agents (such as feline panleukopenia virus [4b[34]] and feline infectious peritonitis virus [4c[35]]), and acute self-limiting emesis of undetermined cause (so-called 'acute gastritis')[5]. Compared with other veterinary species, cats frequently vomit trichobezoars (hairballs) [4c[36]], probably because of their fastidious grooming behaviour. They do not commonly ingest foreign bodies, but when they do, linear foreign bodies (string, sewing thread) are often reported [4a[37], 4b[38]]. Furthermore, cats frequently vomit after administration

Table 3 Non-alimentary tract abdominal disease conditions that have been associated with vomiting in cats

Disorder	Process	Level of evidence and reference(s)	Overall evidence grade
Adrenal gland tumour	Adrenocortical tumour	4d[81]	D
	Extra-adrenal phaeochromocytoma	4d[293]	
Hepatobiliary disease	Chronic hepatitis	4d[56]	B
	Cholangitis/cholecystitis	4c,[57] 4d[58]	
	Extrahepatic biliary tract obstruction	2b[50], 4b[53,54], 4c[59,159,223,294], 4d[63–65]	
	Cysts	4c[60,229], 4d[66]	
	Neoplasia	4b[55], 4c[61], 4d[67,68]	
	Hepatic lipidosis	4a[51], 4d[69,158]	
	Peritoneopericardial diaphragmatic hernia	4d[295]	
	Biliary atresia	4d[70]	
	Biliary cirrhosis	4c[62]	
	Liver flukes	4a[52], 4c[223]	
Mesothelioma		4d[296]	D
Pancreatic disease	Pancreatitis	2b[153], 4a[297], 4c[298], 4d[299–301]	B
	Cyst	4d[152]	
	Neoplasia	4c[150]	
	Exocrine pancreatic insufficiency	4c[302]	
	Pancreatic fluke	4d[303]	
Peritonitis	Bacterial	4a[304], 4b[155,163]	C
	Mycobacterial	4d[305]	
	Actinomycetoma	4d[306]	
	Parasitic	4d[307]	
	Sclerosing peritonitis	4d[161]	
	Haemoperitoneum	4a[162]	
Renal disease	Neoplasia	4d[82,83]	C
	Cysts	4c[229]	
Splenic disease	Neoplasia	4c[91]	C
	Foreign body	4d[92]	
Steatitis		4d[308]	D
Urogenital disease	Uroperitoneum	4c[160]	C
	Ureteroliths/ureteral obstruction	4a[309], 4d[310]	
	Herniated bladder	4d[148]	
	Urethral obstruction	2b[71], 4d[134]	
	Congenital abnormalities	4d[132,225]	
	Endometrial polyps	4c[311]	
	Uterine adenomyosis	4d[133]	
	Uterine rupture	4d[312]	
	Pyometra	4a[313], 4c[314]	
	Prostatic abscess	4d[110]	

of α_2 adrenergic drugs [2b[21,39–42], 4a[43]], reflecting the importance of these receptors in the brainstem areas controlling vomiting. The most common causes of chronic vomiting in cats seem to be idiopathic inflammatory gastritis or enteritis ('inflammatory bowel disease') [4a[44], 4b[45–47], 4c[29,48,49]], adverse reactions to food [4b[28], 4c[29–32]], liver disease [2b[50], 4a[51,52], 4b[53–55], 4c[56–62], 4d[56,58,63–70]] and uraemia [2b[71], 4a[72,73], 4b[74,75], 4c[76], 4d[77,78]]. Hyperthyroidism is common in cats and is also associated with vomiting [4a[79,80]] [OEG D].

Although most causes of vomiting are likely to be the result of the diseases listed above, clinicians should be aware of the many other conditions where vomiting has also been reported (Tables 2–4). Most notably, vomiting has been associated with many non-alimentary diseases, either involving other abdominal organs (Table 3) or other systemic conditions (Table 4), including various types of neoplasia [4c[87], 4d[81–90]], splenic disease [4d[91,92]], many infectious disorders [3b[104], 4a[96], 4b[93,106], 4c[35,94,105], 4d[95]], prostatic abscessation [4d[110]], chronic nasal disease [4a[111]], pyothorax [4b[112]], aortic thromboembolism [4b[113], 4c[114]] and bronchial disease [4a[115,116]]. While these tables can serve as a broad indication of possible differential diagnoses, associations should be made cautiously. In this respect, most of these reports are from isolated case series or single case reports and, as a result, it is impossible to determine

Table 4 Systemic and other disease conditions that have been associated with vomiting in cats

Disorder	Process	Level of evidence and reference(s)	Overall evidence grade
Cardiorespiratory	Chronic nasal disease	4a[111]	C
	Heartworm disease (*Dirofilaria immitis*)	4a[315], 4b[316], 4c[317], 5[230]	C
	Hypertrophic cardiomyopathy	4d[289]	C
	Pyothorax	4b[112]	C
	Thoracic tumours	4d[234,237,318,319]	C
	Aortic thromboembolism	4b[113], 4c[114]	C
	Bronchial disease	4a[115], 4b[116]	C
Drug-induced	Xylazine	2b[21,39–41]	B
	Medetomidine	2b[42], 4a[43]	B
	Cancer chemotherapeutics	2b[178,221,239,240,245,252], 4a[240]	B
	NSAIDs	4b[320], 4c[246,247,321]	C
	Cabergoline	4b[322,323]	B
	Glipizide	2b[324]	C
	Digitalis	4a[325]	B
	Ciclosporin	2b[326]	C
	Numerous others	4b[327]	
Infection	Virulent calicivirus	4b[93], 4c[94]	C
	FeLV	4d[95]	D
	FIV	4a[96]	C
	FIP	4c[35]	C
	Disseminated mycobacterial infection	4c[97], 4d[98–100]	C
	Toxoplasmosis	4d[269,101,102]	C
	Anaplasma phagocytophilum	4d[103]	C
	Trypanosoma evansi	3b[104]	C
	Tularaemia	4c[105]	C
	Ehrlichiosis	4b[106], 4d[107]	C
	Histoplasmosis	4d[108,109]	D
Metabolic	Acute uraemia — vomiting frequently seen	2b[71], 4b[74], 4c[76]	B
	Chronic uraemia — vomiting seen in <1/3 of cases	4a[72,73], 4b[75], 4d[77,78]	C
	Ketoacidosis	4a[147]	C
	Hyperthyroidism	4a[79,80]	C
	Hepatic encephalopathy	5	D
	Hypoadrenocorticism	4c[328], 4d[329]	C
	Hypercalcaemia	4c[236], 4d[149,228,238,330–332], 5[333]	C
	Hypocalcaemia	4a[335]	C
	Hyperkalaemia	4c[335]	C
	Septicaemia/enterotoxaemia	4a[336], 4c[337]	C
	Vitamin D deficiency	4d[338]	D
	Hyperviscosity	4c[339]	C
Neoplastic	Leukaemia	4d[84,85]	C
	Histiocytic disease	4d[86]	D
	Hypereosinophilic syndrome	4c[87], 4d[88–90]	C
	Lymphoma	4b[127], 4c[340], 4d[341]	C
	Systemic mastocytosis	4c[342], 4d[343,344]	C
Neurological disorders	Motion sickness	2b[20,180,184,187,345]	B
	Vestibular disease	4a[346]	C
	Dysautonomia	4c[347,348]	C
	Brain lesions	4d[349,350]	D
Parenteral nutrition		3b[351]	B
Radiation-induced emesis		2b[352]	B
Snake envenomation		4b[353], 4d[354]	C
Toxic	Lilies	2b[226]	B
	Lead	4a[355]	C
	Others	4c[356], 4d[357]	
Transfusion reaction		2b[358]	B

NSAIDs = non-steroidal anti-inflammatory drugs; FeLV = feline leukaemia virus; FIV = feline immunodeficiency virus; FIP = feline infectious peritonitis

the relative importance of these disease associations. Furthermore, the reason for the vomiting is often not explored in detail and may, in fact, have been incidental to the case. For example, two reported infectious causes of vomiting are gastric spiral organisms[117,118] and *Ollulanus tricuspis*,[271] although the evidence in support of a causal link is weak. Indeed, in one of the articles regarding gastric spiral organisms, the authors highlight the fact that other reasons for vomiting were not adequately excluded.[117] Furthermore, in the single article reporting an association between *O tricuspis* infection and vomiting [OEG 4c[271]], only two of the four cats vomited, and both of these cats responded to dietary manipulation.

Clinical presentation and initial assessment

During the initial assessment of cats with vomiting, the severity of the disease process should be determined, with the aim of differentiating those cats that need limited further examination and can be treated symptomatically from those that need extensive investigations or therapy. Although not its primary purpose, the initial assessment may also give a clear indication as to the underlying cause of the vomiting [OEG D].

Assessment starts with the age, breed and gender of the cat, along with presence of signs in other cats in the household. Age is important because some diseases are more common in young cats, such as ingestion of foreign bodies [4a[37]], intussusception [4b[120], 4c[121]], or infectious diseases, such as panleukopenia virus [5[122]], parasites [4a[123,124]] or coronavirus enteritis [4c[125]], while other diseases, such as hyperthyroidism or gastrointestinal or hepatobiliary neoplasia, are more common in older cats [4b[55,127], 4c[126,128]] [OEG C]. Breed is an important consideration: Siamese cats are predisposed to gastrointestinal adenocarcinoma [4c[126]] and to pyloric stenosis [4c[129,130]]; lymphoplasmacytic gastroenteritis is more commonly seen in purebred cats [4c[48]]; and adenomatous polyps of the duodenum are seen more in cats of Asian ancestry [4c[131]] [OEG C]. Adenomatous polyps of the duodenum are more commonly seen in castrated males [4b[131]] and, not surprisingly, some disorders only affect one gender, such as uterine abnormalities [4d[132,133]] or prostatic disease [4d[110,134]] [OEG C].

A complete history is essential for evaluation of a vomiting cat. Information that should be obtained is listed in Table 5. The distinction between vomiting and regurgitation is less clear in cats than in dogs, and cats with megaoesophagus, oesophagitis or hiatal hernia are often reported as vomiting [4b[135], 4c[136], 4d[137–139]]. A sudden onset of vomiting can suggest dietary indiscretion [4c[140]]. Acute onset of vomiting is also seen with intestinal foreign bodies in cats, and the vomiting tends to be persistent and severe [4a[37]]. Furthermore, in approximately one third of cases, the owner either reports seeing the foreign body or it is identified during the physical examination (at the mouth or anus) [4b[38]]. Intermittent vomiting or recurrent episodes more often suggests a chronic alimentary tract disorder, for example, inflammatory bowel disease (IBD) [4d[141]], gastrointestinal neoplasia [4b[142], 4d[143,144]] or hepatobiliary disease [4b[55]]. Furthermore, when haematemesis or melaena are present, gastric adenocarcinoma [4c[145]], gastric ulceration [5], *Physaloptera preputialis* infection [4c[146]] or gastrointestinal polyps [4c[131]] should be considered; in contrast, haemorrhagic diarrhoea (large volumes of fresh blood) can indicate panleukopenia infection [5[122]] and, occasionally, linear foreign bodies [4b[38]]. Given the wide array of possible causes of vomiting (Tables 2–4), clinicians should also pay attention to the presence of other clinical signs. For instance, polydipsia may suggest a systemic disorder, such as renal disease [4d[77,78]], hyperthyroidism [4a[79,80]] or diabetes mellitus [4a[147]], while lower urinary tract disorders should be considered if there is dysuria, pollakiuria or stranguria [4d[134,148,149]]. In such cases, there may also be associated physical examination findings, such as a distended painful bladder in cases of urethral obstruction [4d[134]].

Physical examination is important and should include assessment of the features shown in Table 6. Abdominal palpation is of particular importance given the multitude of abdominal disorders in which vomiting is seen (Tables 2 and 3). In cats, gastrointestinal mass lesions [4b[142], 4c[126]], pancreatic masses [4c[128,150], 4d[82,151,152]] and hepatomegaly [4a[51], 4c[61]] can be identified readily, and can help to narrow the list of possible differential diagnoses and refine the diagnostic approach. Further, gastrointestinal obstructive disorders commonly have abnormalities identified on physical examination [4b[38,120], 4c[121]]. However, while abdominal pain has been reported in cases of pancreatitis [2b[153]], it is suggested to be less consistent than in dogs with pancreatitis [2b[153], 5[154,59]] and is seen with other disorders, including cholecystitis or cholangitis [4c[57]], septic peritonitis, [4b[155]] and gastroduodenal ulceration [4c[156]]. When icterus is seen in vomiting cats, it tends to be due to hepatic and post-hepatic diseases (rather than prehepatic causes), including extrahepatic biliary obstruction [4b[53,54,59], 4d[65,157]], cholecystitis or cholangitis/cholangiohepatitis [4c[57], 4d[58]], hepatic lipidosis [4a[51], 4d[69,158]], cholelithiasis [4c[159]], and hepatobiliary neoplasia [4c[61]]. Finally, careful palpation of the cervical area should be performed in all older cats with chronic vomiting, given that a palpable goitre is usually noted when hyperthyroidism is present [4a[80]].

From the signalment, history and physical examination, the clinician should be able to categorise the patient as systemically 'well' (stable patient with no criteria for further assessment or treatment; Table 7) or 'unwell'

Table 5 History taking for the vomiting cat

A thorough history should be obtained during the initial assessment, including the following:	Rationale [level of evidence/reference]	Overall evidence grade
Distinguish vomiting from regurgitation	Not always easy in cats. The presence of regurgitation suggests oesophageal disease [4b[135]]	C
Onset and progression of signs	Sudden onset can suggest ingestion of foreign body or dietary indiscretion [4c[140]] Chronic or recurrent vomiting may indicate the presence of a chronic gastrointestinal problem, eg, intestinal adenocarcinoma [4b[142]], other intestinal tumour [4d[144]], gastrinoma [4d[292]], gastric carcinoid [4d[143]] or a hepatobiliary mass [4b[55]] Persistent vomiting can be seen in cats which have ingested thread and sewing needles [4a[37]] Chronic intermittent vomiting can be seen with IBD, eg, lymphoplasmacytic gastritis [4d[141]]	C
Description of the vomitus	Presence of bile suggests patent pylorus [5] Faecal odour may suggest obstruction [5]	D
Haematemesis	Can be seen with gastric adenocarcinoma [4c[145]], gastric ulceration [5], intestinal polyps [4c[131]] and feline acute haemorrhagic vomiting syndrome [5[260]]	C
Relationship to eating	Vomiting food >12 h after eating suggests delayed gastric emptying [5]	D
Concurrent constipation and tenesmus	Can be found in cats with colonic adenocarcinoma [5[166]], megacolon [5[359]] or other gastrointestinal obstruction [4c[255]] Tenesmus may be seen with prostatic disease or sublumbar masses [4d[110,134,257]]	C
Presence of diarrhoea	Diarrhoea may suggest concurrent intestinal disease [4c[48,121,128]], 4d[151], 5[122]]	C
Bloody diarrhoea	Can be seen in feline panleukopenia infections [5[122]] Can be seen in some cats with linear foreign body [4b[38]]	C
Melaena	Can be seen with gastric adenocarcinoma [4c[145]] Can be seen in cats with *Physaloptera preputialis* nematodes [4c[146]]	C
Appetite, nutritional status and weight loss	Weight loss associated with gastrointestinal tumour [4c[126]], intussusception [4b[120]], chronic diaphragmatic hernia [4c[262]], hepatic lipidosis [4a[51]], various malignancies (including intestinal adenocarcinoma [4b[142]] and lymphoma [4c[128]], 4d[151]]), parasitic infestation of the stomach [4c[146,271,360]] and *Mycobacterium* species infection [4d[305]], many other diseases	C
Fluid intake (increased, decreased or normal)	Polydipsia may be seen with kidney disease [4d[77,78]], hyperthyroidism [4a[79,80]] or diabetes mellitus [4a[147]]	C
Micturition behaviour, dysuria, anuria	May be a sign of feline lower urinary tract disease, including urethral obstruction or herniation of the urinary bladder in the inguinal canal [4d[134,148,149]] Anuria can be seen in rupture of bladder or urethra [4b[160]]	C
Presence of abdominal pain	Abdominal pain can be seen in pancreatitis [2b[153]] or with intussusception [4b[120]]	B
Diet changes, recent drug therapy, access to toxins or foreign bodies	Change in diet can cause vomiting [5] Trichobezoars can cause vomiting [4c[36]] Scavenging on chicken remnants can cause enterotoxaemia [4c[361]] The owner observes the linear foreign body in a third of cases [4b[38]] Postoperative vomiting reported after extrahepatic biliary tract surgery [4c[362]] and ovariohysterectomy (if concurrent ureteral obstruction or section [4d[310]])	C

(Continued)

Table 5 (Continued)

A thorough history should be obtained during the initial assessment, including the following:	Rationale [level of evidence/reference]	Overall evidence grade
Vaccination status	Feline panleukopenia virus enteritis more likely to be seen in unvaccinated cats than in vaccinated cats [5[122]]	D
Concurrent dermatological signs	Concurrent occurrence of gastrointestinal and dermatological signs can suggest an adverse reaction to food [4c[30,31]]	C
History of hypertrophic cardiomyopathy and aortic thromboembolism	Secondary small bowel infarction [4d[290]]	D
Ptyalism and depression	Can be seen in hepatoencephalopathy [4a[51]] Depression is mentioned in many disease conditions	C
Outdoor cat	This may suggest trauma leading to diaphragmatic hernia, septic peritonitis, bladder rupture [4b[155]]	C
Hormonal treatment for oestrus prevention	Uterine abnormalities such as pyometra [4c[314]]	D
Vaginal bleeding, vulvar discharge	Can be seen with endometrial polyps [4c[311]] and pyometra [4c[314]]	C

(unstable patient with one or more criteria for intervention), establish a problem list, and identify appropriate diagnostic investigations and therapy [OEG D].

Diagnostic approach

Cats with simple, mild, acute self-limiting emesis do not need further investigation, and can be treated symptomatically (see below) or simply monitored [OEG D]. In such cases, signs resolve after 1–2 days, with or without symptomatic and supportive therapy. However, this syndrome of acute and self-limiting emesis, a common reason for dogs presenting to veterinary surgeons, is probably less common in cats, and cats that are presented are relatively more likely than dogs to require treatment and investigation [OEG D]. Suggested criteria, whereby further assessment and management should strongly be considered when identified in a cat that is vomiting, are shown in Table 7 [OEG D]. These include: frequent acute vomiting [4a[37], 4c[140]], the presence of blood in the vomitus or melaenic faeces [4c[131,145,146,156]], abdominal pain [2b[153], 4b[160], 4c[156], 4d[92,161]], abdominal distension [4a[120,162], 4b[163]] and pyrexia [2b[153], 4c[57], 5[122]]. Other criteria that suggest the need for further intervention include severe dehydration, signs of shock, a history of vomiting for more than 2 weeks or persistent vomiting despite symptomatic treatment [5]. All of these latter criteria have been suggested by expert opinion; although we would agree that these criteria are sensible, no objective information in support of their use could be identified.

Where signs of dehydration, shock or hypothermia are present, intravenous fluid resuscitation should be a priority and further examinations should also be considered, including haematological examination, a biochemistry profile and urinalysis [5]. If no abnormalities are discovered by abdominal palpation, it is appropriate to await the results of haematological examination, biochemistry profile and urinalysis [5]. In cats >6 years old, total T_4 measurement should be considered in addition to routine clinicopathological assessments, given the possibility of hyperthyroidism [4a[79,80]] [OEG D].

Thoracic radiographs are indicated if the cat is dyspnoeic, tachypnoeic, has abnormalities on auscultation or if there is a suspicion of oesophageal disease based on the presenting history [4b[135], 4c[136], 4d[137–139]]. Diagnostic imaging of the abdomen should be considered in any vomiting cat, especially if abnormalities are found on abdominal palpation (eg, abdominal pain, mass, thickened intestines) [4a[51], 4b[142], 4c[61,126,128,150], 4d[82,151,152]]: ultrasonography is the most appropriate imaging modality in many cases, but the information obtained is often complemented by the findings of radiography. Contrast radiography, endoscopy, exploratory coeliotomy or laparoscopy may also be considered (Table 8). If the cat is icteric, hepatic ultrasonography (with liver fine needle aspiration cytology, biopsy and/or cholecystocentesis) is indicated [OEG D].

There are numerous causes of gastrointestinal obstruction in small animals, but several are more commonly seen in cats, namely linear foreign bodies [4a[37], 4b[38]], trichobezoars [4c[36]], focal intestinal neoplasia [4b[142,164], 4c[128,131,165], 4d[144,151,157]] and megacolon [5[166]] [OEG D]. When diagnostic imaging findings suggest obstruction, exploratory coeliotomy should be performed [OEG D].

In those cases where further investigation is considered necessary or abnormalities are identified on initial diagnostic tests, a variety of other diagnostic tests may be

Table 6 Important considerations in the physical examination of the vomiting cat

Physical examination of the vomiting cat should include assessment of:	Rationale [level of evidence/reference]	Overall evidence grade
Abdominal palpation	Intestinal thickening and mesenteric lymph node enlargement may be caused by lymphoma [4c[128], 4d[151]] Palpable abdominal mass may be found with intussusception [4b[120], 4c[121]], gastrointestinal adenocarcinoma [4b[142], 4c[126]], pancreatic cysts [4d[152]], encapsulated peritonitis (eg, isolated abdominal fat necrosis) [4d[161,308]] Gastrointestinal obstruction is usually recognised by abdominal palpation [4b[38], 5[359]] Cranial abdominal pain can be seen in cholecystitis or cholangitis [4c[57]], acute pancreatitis [2b[153]], septic peritonitis [4b[155]], uterine adenomyosis [4d[133]] and gastroduodenal ulceration [4c][156] Large, painful bladder in urethral obstruction [4d[134,148,149]] Hepatomegaly could indicate hepatic lipidosis [4d[139]] or hepatobiliary tumour [4c[61]] Other palpable abnormalities include enlarged mesenteric lymph nodes [4d[305]], splenic haemangiosarcoma [4c[91]], perirenal (pseudo-) cyst [4d[82]], pancreatic tumours [4c[150]] and intra-abdominal actinomycetoma [4d[306]]	C
Rectal temperature	Pyrexia can be seen with panleukopenia virus [5[122]], cholecystitis or cholangitis/cholangiohepatitis [4c[57], 4d[58]], acute pancreatitis [2b[153]], chronic hepatitis [4d[56]], prostatic abscess [4d[110]] and *Mycobacterium* species infection [4d[305]]	C
Oral examination, inspection of anus	Ingestion of thread and sewing needle can be diagnosed with abdominal palpation and oral examination [4a[37]] Linear foreign body is visible at mouth or anus in one-third of cases [4b[38]]	C
Abdominal distension/ effusion	Seen in uroperitoneum [4b[160]], septic peritonitis [4d[92]], sclerosing encapsulating peritonitis [4d[161]], chronic hepatitis and cirrhosis [4d[56]] and uterine enlargement [4a[309], 4d[225,312]]	C
Dehydration, pale mucous membranes, hypothermia, tachycardia	Can be with intussusception [4b[120]] and haemoperitoneum [4c[91]] Fluid therapy should be given to a dehydrated cat [5]	C
Dyspnoea	Diaphragmatic hernia and accompanying gastric dilatation-volvulus causes severe dyspnoea and needs to be treated without delay [4c[265]] Can be seen with haemoperitoneum [4c[91]]	C
Icterus	Can be seen in extrahepatic biliary obstruction [4b[53,54,59], 4d[65,157]], cholecystitis or cholangitis/cholangiohepatitis [4c[57], 4d[58]], hepatic lipidosis [4a[51], 4d[58,69]], cholelithiasis [4c[159]], hepatobiliary tumour [4c[61]], biliary mucocoele and pancreatic tumour [4c[150]]	C
Size of the bladder	May see distended urinary bladder in urethral obstruction [4d[134]]	D
Lymph node enlargement	Can occur in *Mycobacterium* species infection [4d[305]] and lymphoma	D
Palpation of cervical area	Palpable goitre can be noted with hyperthyroidism [4a[80]] or hyperparathyroidism [4c[149]]	C
Skin fragility	Reported in cholangiohepatitis and hepatic lipidosis [4d[158]]	D
Nasal discharge	Vomiting is commonly associated with nasal disease [4a[111]]	C
Vaginal discharge	Pyometra can cause vomiting [4c[314]]	C
Neurological examination	Central nervous system disease can cause vomiting [5]	D

indicated (Table 8). Additional tests to be considered include other blood tests (eg, trypsin-like immunoreactivity, pancreatic lipase, folate and cobalamin, lactate, coagulation tests), serology (eg, testing for feline leukaemia virus, feline immunodeficiency virus and coronavirus), faecal examinations [for flotation, culture, cytology and/or polymerase chain reaction (PCR)], examination of the vomitus, examination of peritoneal or thoracic effusion, fine needle aspiration cytology of any abnormal organs or masses found, testing for heartworm infection (in endemic areas), advanced imaging and an elimination diet trial. Furthermore, either endoscopy or exploratory coeliotomy can be used to examine the alimentary tract directly and to collect biopsies. Biopsies can then be used for histopathology, immunohistochemistry (to identify cell lineages and *Coronavirus*), fluorescence in situ hybridisation (to identify

Table 7 Criteria suggesting the need for further intervention in vomiting cats

A number of findings might indicate need for further investigation	Rationale [level of evidence/reference]	Overall evidence grade
Nature of the vomiting		
Frequent acute vomiting, vomiting large volumes, vomiting contents of a fetid nature	May be a sign that inpatient care is needed [5] Needs investigation in case surgical intervention is required (eg, intestinal obstruction) [5]	D
Haematemesis	Can be seen in cats with gastric adenocarcinoma [4c[145]], intestinal polyps [4c[131]] and gastric ulceration [4c[156]]	C
Other gastrointestinal signs		
Melaena	Can be seen in cats with gastric adenocarcinoma [4c[145]] Can be seen in cats with *Physaloptera preputialis* nematodes [4c[146]]	C
Abdominal pain	Can be seen with gastrointestinal ulceration [4c[156]] or peritonitis [4d[161]], although other causes are possible [5]. However, it is less commonly seen in cats with pancreatitis than dogs with pancreatitis [2b[153], 5[154]]	C
Abdominal swelling or free fluid	Can be a sign of peritonitis [4b[163]], haemoperitoneum [4a[162]], hypoalbuminaemia, FIP, hepatic disease and other diseases requiring further investigation [5]	C
Weight loss/failure to thrive	Suggests chronic disease process requiring further investigation [5] Severe recent weight loss associated with hepatic lipidosis [4a[51]] Can be associated with malignancies [4b[142,164], 4c[128], 4d[151]]	C
Other clinical signs		
Pyrexia	Can be seen in cats with panleukopenia virus [5[122]], cholangitis/cholangiohepatitis [4c[57]], acute pancreatitis [2b[153]] and other diseases requiring further investigation [5]	C
Severe dehydration/hypovolaemia/ hypothermia/shock	Fluid therapy indicated [5]	D
PU/PD	Seen in renal disease [4b[75]], diabetes mellitus [4a[147]], hyperthyroidism [4a[80]], hypoadrenocorticism [4c[328]] and other diseases [5]. However, unlike dogs, hypercalcaemic cats infrequently present with PU/PD [4a[363], 4b[364], 4c[365]]	C
Bradycardia (absolute or relative to volume status)	Can be seen in hypoadrenocorticism [4c[328]] and electrolyte abnormalities [2b[71]]	C
Marked malaise	Rarely seen in mild, self-limiting diseases [5]	D
Other abnormal physical examination findings, eg, pale mucous membranes, jaundice, neurological signs, dysrhythmias, palpably enlarged thyroid	May indicate a specific disease requiring investigation and intervention	D
Timeframe and response to therapy		
Chronicity (>2 weeks duration)	Suggests the disease process is not self-limiting and that further investigation is needed [5]	D
Failure of symptomatic treatment	Needs further investigation [5]	D

PU/PD = polyuria/polydipsia; FIP = feline infectious peritonitis

invasive bacteria), bacterial culture or PCR, if indicated by specific findings in the history or physical examination, and depending on availability [OEG D]. When endoscopy is performed, either the upper alimentary tract (eg, oesophagus, stomach and duodenum) the lower gastrointestinal tract (eg, rectum, colon, caecum and ileum) or both can be examined. Recent evidence suggests that, for some causes of vomiting (eg, IBD), both regions should be examined because the results of histopathological examination may not correlate [4a[167]]. Exploratory coeliotomy may be more suitable in some cases of vomiting because of the frequency with which lesions outside the gastrointestinal tract are noted in cats with gastrointestinal signs [4b[168]] [OEG C]. These recommendations are made based on the

Table 8 Diagnostic tests used in the investigation of cats with vomiting

Diagnostic test	Information obtained	Overall evidence grade
Tests commonly used in current clinical practice		
Elimination diet		
	Use in the diagnosis of adverse reactions to food [4c[30,31]]	C
Haematology		
	Anaemia can be seen with IBD [4b[366]], nematode infection [4c[146]], intestinal polyps [4c[131]], acute pancreatitis [2b[153]] and primary hyperparathyroidism [4c[149]] Leukocytosis can be seen with IBD [4b[366]], *Mycobacterium* species [4d[305]], lymphoma [4c[165]] and pancreatic tumour [4c[150]] Leukopenia can be seen with IBD [4b[366]] and FPLV [5[122]] Large granular lymphocytes can be seen with intestinal lymphoma [4c[165]] Eosinophilia can be seen with intestinal lymphoma [4d[151]], food allergy [4c[31]], hypereosinophilic syndrome [4c[87]] and nematode infection [4c[146]] Dehydration and haemoconcentration are possible consequences of vomiting [5] Erythrocytosis-induced hyperviscosity causes vomiting [4c[339]]	C
Clinical biochemistry		
Urea and creatinine	Azotaemia seen in renal disease [4b[75]], urinary tract obstruction, dehydration, hypercalcaemia and uroperitoneum	C
Total protein, albumin	Hyperproteinaemia seen in IBD [4b[366]] and many other conditions Hypoproteinaemia seen in IBD [4b[366], 4c[48]], lymphoma [4c[267]], *Mycobacterium* species infection [4d[305]], septic peritonitis [4b[155]] and many other conditions	C
Hepatic enzymes and bilirubin	Can be increased in cats with IBD [4c[48]], lymphoma [4c[165]], hepatic lipidosis [4a[51], 4d[69]], extrahepatic biliary obstruction [2b[50], 4b[54], 4c[53,59,223], 4d[63,65]], cholangitis [4d[158]], hepatobiliary masses [4c[55]], pancreatic tumour [4c[150]] and hyperthyroidism (liver enzymes not bilirubin) [4a[367]]	C
Blood glucose	Diagnosis of diabetes mellitus [4a[147]]	C
Cholesterol	Hypocholesterolaemia can be seen in IBD [4b[366]]	C
Sodium, potassium and chloride	Electrolyte changes are a common consequence of vomiting [5] Hyperkalaemia seen in urethral obstruction [2b[71]] Hyperkalaemia and hyponatraemia are occasionally seen in hypoadrenocorticism [4c[327]], but also with other conditions, including gastrointestinal disease, renal disease, cardiorespiratory disease and body cavity effusions [4b[368]]	C
Calcium and phosphate	Diagnosis of hypercalcaemia [4a[308], 4c[235], 4d[149,228,238]]	C
Urinalysis		
	Can assist in the diagnosis of kidney disease and lower urinary tract disease [5]	D
Faecal analyses		
	Flotation for *Isospora* species, *Giardia* species cysts, *Cryptosporidium* species oocysts, coccidial oocysts and *Cyniclomyces guttulatus* [4a[123,124,281], 4d[279]] Bacterial culture for *Salmonella* species [4a[277]] SNAP test for *Giardia* species [4a[123,369]]	C
Specific gastrointestinal tests		
Cobalamin	Cobalamin deficiency occurs with diseases in the intestines, pancreas or hepatobiliary system [4b[370], 4c[302]] Identify need for supplementation which can ameliorate signs of severe hypocobalaminaemia [4b[370], 4c[371]]	C
Lipase	Increased in experimental pancreatitis [2b[153]], but can be unhelpful in clinical cases [5[169,372]]	C
fTLI	Increased in pancreatitis [4d[69], 5[154,169]], but false-positives and false-negatives occur [3b[372,373]]	C
	Decreased in EPI [4d[301], 5[154]]	B
fPLI	Increased in pancreatitis [3b[374]], but can get mild increases in some cats without pancreatitis signs [3b[375]]	
Diagnostic imaging		
Thoracic radiography	For diagnosis of diaphragmatic hernia [4c[262], 4d[263]] Megaoesophagus, gastro-oesophageal intussusception [4d[137,138]] Lymphadenopathy in *Mycobacterium* species infection [4d[305]] Metastases, eg, in pancreatic tumours [4c[150]] Bronchogenic adenocarcinoma [4d[238]]	C

(Continued)

Table 8 (Continued)

Diagnostic test	Information obtained	Overall evidence grade
Abdominal radiography	Usually normal in cats with IBD [4b[366]] Diagnosis of obstruction or linear foreign body [4a[37], 4b[38,120], 4c[126]], intestinal neoplasia (including colonic adenocarcinoma) [4b[142], 4c[256]], mesenteric lymphadenopathy [4d[305]], pancreatic masses caused by neoplasia, cysts or pseudocysts [4c[150], 4d[152,299]], uterine enlargement [4d[133]], ureteral calculi [4a[309]], calcium oxalate urolithiasis [4d[149]], splenic tumour and haemoperitoneum [4c[91]]	C
Abdominal ultrasonography	Ultrasonographic findings may correlate with histological grade of IBD in cats [4b[366]] Intussusception can be diagnosed with ultrasonography [4b[120]] Luminal narrowing or a colonic mass can be seen in cats with colonic adenocarcinoma [4c[256]] Can identify gastric wall thickening [4d[232,268]], ileocaecocolic abnormalities [4b[376]], linear foreign bodies [4b[38]], extrahepatic biliary obstruction [4b[53,54], 4c[223], 4d[63,65,157]], small bowel infarction and local peritonitis [4d[289]], pancreatitis [5[154]], pancreatic cysts [4d[152]], pancreatic tumours [4c[150]], liver disease [4d[58,69]], uterine abnormalities [4a[309,313], 4d[132,133]], ureteral calculi [4a[309,313]], diaphragmatic hernia [4c[262]], prostatic abscess [4d[110]], splenic masses [4c[91]], hepatobiliary tumours [4c[61]], renal and perirenal cysts, and pseudocysts [4c[229], 4d[82]]	C
Ultrasound-guided FNA Cytology	Alimentary lymphoma [4b[164]] Prostatic abscess [4d[110]] Useful to investigate abnormalities in many organs [5]	C
Biopsy collection and examination		
Endoscopy	Severity and type of inflammation in IBD [4b[366]] Hyperaemia, haemorrhage, and roughened or cobblestone mucosa in LPE [4c[48]] Identification of oesophageal, gastric and duodenal abnormalities [4c[131], 4d[232], 5[377]]	C
Exploratory coeliotomy	Diagnosis of abdominal disorders such as intestinal obstruction (including *Taenia taeniaeformis*) [4d[224]], pancreatitis [4d[294]], chronic hepatitis and cirrhosis [4d[56]], septic peritonitis [4b[155]], prostatic carcinoma [4d[134]], multiple cystic intestinal duplications [4d[119]] and many other abnormalities	C
Liver biopsy	Liver disease [4a[51]]	C
Histopathology	Diagnosis of IBD and neoplasia (including lymphoma) [4b[47,164], 4c[128], 4d[141,143]] Identify *Ollulanus tricuspis* [4c[271,360]] Diagnosis of pancreatitis, chronic hepatitis and cirrhosis [4c[298], 4d[56]]	C
Tests used occasionally		
Examination of the vomitus	Can reveal *O tricuspis* or *Physaloptera preputialis* nematodes [4c[146,271,360]]	C
Blood pressure	Hypertension can be associated with renal disease or hyperthyroidism [4c[229]]	C
Electrocardiography	Dysrhythmias or bradycardia in cardiac disease or metabolic disturbances (eg, hyperkalaemia) [4c[335]]	C
Coagulation tests	Required prior to liver biopsy [5]. Can be abnormal in cats with hepatic lipidosis [4a[51]]	C
ACTH stimulation test	Hypoadrenocorticism can cause vomiting [4c[328]]	C
Blood gas analysis	Guides fluid therapy [5]	D
Lactate	Increased in septic peritonitis [4b[155]]	C
Heartworm (*Dirofilaria immitis*) testing: antigen, antibody	In endemic areas. Vomiting is a frequent sign in *D immitis* infection in cats [4a[315], 4b[316], 5[230]]	C
Cholecystocentesis	Bacterial culture of bile to diagnose cholecystitis or cholangitis [4c[57], 4d[58]] Identification of liver fluke (*Platynosomum concinnum*) [4c[223]]	C
Cytology/bacterial culture of peritoneal effusion	Peritonitis (including septic peritonitis) [4b[155,163], 4c[164], 4d[92,161,305]] and haemoperitoneum [4a[162], 4c[91]]	C

(Continued)

Table 8 (Continued)

Diagnostic test	Information obtained	Overall evidence grade
Creatinine and potassium (in peritoneal effusion)	Indicator of uroperitoneum suggesting leakage from urinary tract [4c[160]]	C
Laparoscopy	Can be used to evaluate the pancreas [4c[378]]	C
Tests not commonly used or limited in their availability		
Gastrin	Increased in several diseases; suggestive of gastrinoma [4d[292]]	D
Contrast radiography	Identify gastrointestinal lesions, including IBD [4c[365]], gastric neoplasia [5[377]], megaoesophagus [4d[263]] and duodenal polyps [4c[131]] Positive contrast radiography to check for rupture of urinary bladder or urethra [4b[160]] Excretory urography for ureter dissection [4d[308]]	C
CT scan	Evaluate abdominal organs; not yet proven to be useful in the diagnosis of feline pancreatitis [3b[374]]	D
CT scan and labelled leukocytes	Can be used in diagnosis of pancreatitis [4d[299]]	D
MRI	Evaluation of CNS disease [5]	D
Endoscopic aspiration of intestinal contents	To identify *Giardia* species trophozoites (if zinc flotation of faeces is negative and the cat is not on treatment) [4a[379]]	C
Immunohistochemistry	Coronavirus enteritis [4c[125]] Immunological markers aid in characterisation of IBD in the research setting [4b[45]] Classify alimentary lymphoma and distinguish lymphoma from intestinal inflammation [4b[46],4d[151]]	C
PCR or Warthin-Starry staining on gastric mucosa	Infection with *Helicobacter* species [4b[118]]	C
FISH in tissue biopsies	Gastric *Helicobacter heilmannii* infections are associated with gastric MALT lymphoma [4b[285]] Can be used to identify *Helicobacter* species in cats with gastritis [4c[117]]	C
PCR on tissue biopsies	Can reveal *Anaerobiospirillum* species in cats with ileocolitis [4c[278]]	C

fTLI = feline trypsin-like immunoreactivity; fPLI = feline pancreatic lipase immunoreactivty; FNA = fine needle aspirate; ACTH = adrenocorticotropic hormone; CT = computed tomography; MRI = magnetic resonance imaging; PCR = polymerase chain reaction; FISH = fluorescent in situ hybridisation; IBD = inflammatory bowel disease; FPLV = feline panleukopenia virus; SNAP = SNAP *Giardia* test; EPI = exocrine pancreatic insufficiency; LPE = lymphoplasmacytic enteritis; CNS = central nervous system; MALT = mucosa-associated lymphoid tissue

available evidence but, as shown in Table 8, this evidence is frequently only of level 4 or 5. For example, it has long been accepted that assays for total amylase and total lipase are not useful in the investigation of pancreatitis in cats. While this may be true, the only objective evidence currently available for this supposition is a meeting abstract [5[169]].

Treatment

Vomiting is unpleasant for cats and distressing to owners, and can be associated with adverse consequences, including anorexia, weight loss, food aversion and disturbances of fluid, acid–base and electrolyte balance. It may also cause aspiration pneumonia in severely sick cats [OEG D]. Although most cases of acute vomiting are likely to resolve without specific treatment, no objective data are available to determine the likelihood of this happening. When vomiting does not resolve spontaneously, a diagnosis should be sought to allow specific treatment of the underlying cause. Pending results of investigations, supportive care for the vomiting cat can include fluid and electrolyte therapy, and antiemetics (see below). However, antiemetics may be contraindicated where there is gastrointestinal obstruction [OEG D].

Antiemetic therapy

To date, there are no published clinical trials of antiemetics in naturally occurring cases of emesis in cats. Therefore, information on antiemetic efficacy must be drawn from experimental studies. In interpreting the results of these studies, consideration should be given to the emetic stimulus used in the study and, therefore, the likely emetic pathways involved. Certain important differences exist between dogs, cats and ferrets — the three species most

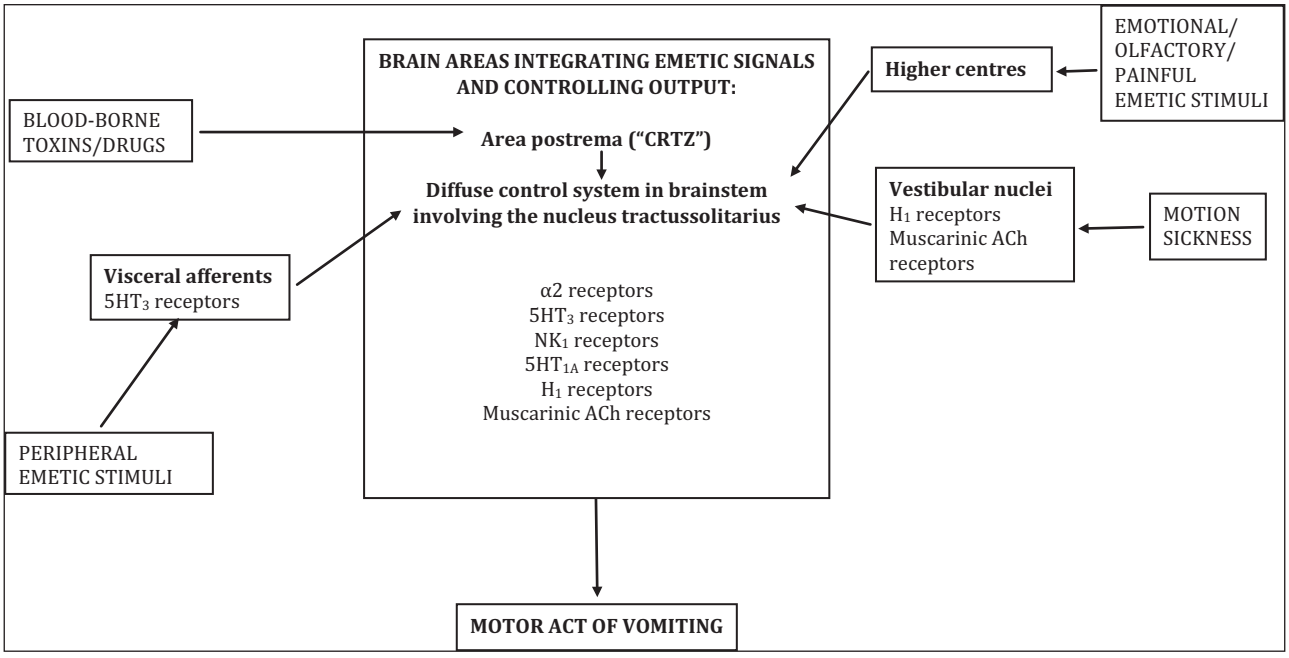

Figure 1 Schematic diagram showing receptor types potentially involved in emetic pathways in the cat [OEG B]. 5HT = serotonin (5-hydroxytryptamine); α_2 receptor = alpha-2 adrenergic receptor; ACh = acetyl choline; CRTZ = chemoreceptor trigger zone; H_1 receptor = histamine type 1 receptor; NK_1 = neurokinin 1

commonly used in experimental emesis research and, therefore, extrapolating the results of experiments in different species to cats must be undertaken with caution. For example, D_2 dopamine receptors in the AP are much less important in cats than in dogs, explaining the comparative resistance to apomorphine-induced vomiting cats [2b[17,170]]. In contrast, α_2 adrenergic receptors are important in the areas of the cat brainstem controlling vomiting, explaining why the α_2 agonist xylazine is an effective emetic agent in cats [2b[171–173]]. A schematic diagram showing the various receptors implicated in emesis in cats is shown in Figure 1 [OEG B].

The antiemetics available in veterinary practice, and evidence of efficacy, are shown in Table 9. As mentioned above, published evidence in support of their use in this species is limited. The most effective antiemetics for cats appear to be those that work via NK_1 (eg, maropitant) or serotonin (5-hydroxytryptamine, $5HT_3$) (eg, ondansetron) receptors [OEG B]. Drugs with α_2 antagonist activity are anecdotally reported to be effective antiemetics in cats, but robust evidence to support their use is lacking [OEG D].

Chlorpromazine was not effective against emetogens working via the AP in cats [3b[174]], and there are no published reports on the use of prochlorperazine as an antiemetic in cats.

Although often listed as a first line antiemetic, metoclopramide, a D_2 antagonist, is of questionable use as a central antiemetic in cats, and it failed to block the emetic response to dopamine administration in cats [2b[173]]. Administration of metoclopramide to cats prior to xylazine injection reduced the frequency of emetic events in one study, but not in another [3b[40,175]]. The possibility that tolerance to xylazine caused the reduction in emetic events was not adequately excluded in that study.[40] Metoclopramide may be used in some circumstances where a gastrointestinal prokinetic action is desired, for example for ileus or delayed gastric emptying, but its prokinetic action is weak in the cat [2b[176,177]] [OEG B].

The $5HT_3$ receptor antagonist granisetron was effective against the acute phase of cisplatin-induced emesis (peripheral emetogen) in cats [2b[178]], and there are anecdotal reports that the related drug dolasetron is also effective in this species [5[179]]. In laboratory studies $5HT_3$ receptor antagonists prevented cisplatin-induced vomiting, but not vomiting induced by xylazine or motion [2b[180]]. Ondansetron reduced the severity of dexmedetomidine-induced nausea and vomiting in healthy cats, but only if given at the time of dexmedetomidine administration [2b[181]]. These drugs appear to act via peripheral $5HT_3$ receptors, although action at central sites may contribute to their efficacy [2b[178,180,182,183]] [OEG B].

Maropitant is a potent, highly selective NK_1 receptor antagonist, which is well tolerated and safe in cats [2b[184]]. In a preliminary study, at the dose used in dogs (1 mg/kg SC), maropitant was effective in preventing xylazine-induced emesis (central emetogen) and motion sickness-induced vomiting in cats [4d[184]]. It was effective when given subcutaneously or orally, and had a half-life in the cat suitable for once-daily dosing. However, use in larger numbers of cats is needed before

Table 9 Antiemetic drugs in cats

Drug	Dose	Receptor pharmacology	Pathways inhibited	Other actions	Adverse effects and contraindications	Level of evidence and reference(s)	Overall evidence grade (antiemetic action)
Phenothiazines							
Chlorpromazine	0.3–0.5 mg/kg IM q8h	α_2 antagonist D_2 antagonist H_1 antagonist $5HT_3$ antagonist Muscarinic ACh antagonist	Central emetogens? Motion sickness?	α_1 antagonist	Prelicensing safety studies not performed Decrease blood pressure, especially if dehydrated Sedative effects Behavioural effects May potentiate movement disorders associated with metoclopramide	3b[174]	– (Not effective against centrally acting emetogens in this study)
Prochlorperazine	0.1–0.5 mg/kg SC, IM, IV q6–8h or 0.5–1.0 mg/kg PO q8–12h					No published data to support its use as an antiemetic in the cat	–
Metoclopramide	0.2–0.5 mg/kg IM, SC, PO q6–8h or 1–2 mg/kg IV over 24 h as CRI	D_2 antagonist $5HT_3$ antagonist at higher dose	D_2 receptors not thought to be important in central vomiting pathways in cats	Variable prokinetic effect may contribute to antiemetic effect	Prelicensing safety studies not performed Movement disorders/frenzied behaviour Reduce dose by 50% in renal failure Contraindicated in intestinal obstruction May reduce the frequency of emetic events after xylazine administration	3b[40,175]	C
Selective $5HT_3$ antagonists							
Ondansetron	0.5 mg/kg IV loading dose followed by 0.5 mg/kg IV infusion for 6 h or 0.5–1.0 mg/kg PO q12–24h	$5HT_3$ antagonist	Work well vs cisplatin-induced emesis, especially the acute phase (relatively ineffective against the delayed phase)		Prelicensing safety studies not performed. Contraindicated in intestinal obstruction Considered safe — headaches and CNS signs reported in humans QT segment alterations reported in humans after dolasetron use	2b[181]	– (Reduced the severity of dexmedetomidine-induced nausea and vomiting in healthy cats, but only if given with the dexmedetomidine)
Granisetron	1 mg/kg IM q8h					2b[178]	B
Dolasetron	0.6–1.0 mg/kg IV or PO q24h					5[179]	D

(Continued)

Table 9 (Continued)

Drug	Dose	Receptor pharmacology	Pathways inhibited	Other actions	Adverse effects and contraindications	Level of evidence and reference(s)	Overall evidence grade (antiemetic action)
Maropitant	1 mg/kg SC or PO q24h	NK_1 antagonist	Broad spectrum antiemetic Effective vs peripheral and central emetogens and prevents vomiting induced by motion sickness		Pain on injection (may be reduced by refrigerating the solution) Highly protein-bound; use with caution in hypoproteinaemia or when giving with other highly protein-bound drugs	2b[184]	B

$5HT_3$ = serotonin (5-hydroxytryptamine); CRI = constant rate infusion; ACh = acetylcholine; NK_1 = neurokinin 1; CNS = central nervous system

strong recommendations can be made for its efficacy and to identify any uncommon adverse effects [OEG B].

For the treatment or prevention of motion sickness in cats, NK_1 receptor antagonists are effective in the laboratory setting.[184,185] Antihistamines are thought to be effective against motion sickness in some species. However, in cats, although an irreversible inhibitor of histamine synthesis prevented motion sickness, an H_1 antagonist did not [OEG B] [2b[186]].

$5HT_{1A}$ receptor agonists were shown to be effective against a range of emetic stimuli in the cat, but have not found their way into the clinic [2b[187–190]]. In particular, many cats showed marked defensive behaviour with these drugs, limiting their use [OEG B].

A variety of other drugs have been assessed for antiemetic effects in cats, but are not likely to be useful antiemetics in a clinical setting [OEG B] [2b[191–200]].

Dietary management

Many vomiting cats are systemically well and have self-limiting conditions, for example acute gastroenteritis. Dietary recommendations for this group are commonplace in review articles, but have little scientific basis [5[201,202]]. Nonetheless, the self-limiting nature of clinical signs in these cases, and absence of evidence to the contrary, mean that these practices will likely continue for the current time.

The standard dietary recommendation for cats with acute gastrointestinal disorders is to withhold food for 24–48 h, followed by administration of small quantities of a bland, highly digestible diet three or four times per day for 3–7 days [5[203,204]]. Such short-term fasting is said to provide 'bowel rest', thereby reducing gastrointestinal secretions and bacterial numbers, while avoiding the adverse effects of non-absorbed, osmotically-active food particles [5[203,204]]. Arguably, the bowel can also be 'rested' if a highly digestible diet is fed, as this is assimilated rapidly in the proximal small bowel [5[201]] [OEG D].

In contrast, in human gastroenterology there is strong evidence in favour of feeding during gastroenteritis [2b[205]]. Unfortunately, there are no equivalent published studies in cats. Some authors have argued that continuing to feed may exacerbate vomiting. Further, if present, diarrhoea may be exacerbated by the osmotic action of luminal food particles. For these reasons, food withholding is likely to remain as the most widely adopted strategy. That said, care must be taken in sick cats, especially if they are obese, given concerns over invoking hepatic lipidosis, a consequence of starvation in an obligate carnivore [2b[206–208]] [OEG C].

The term 'bland diet' is used commonly but defined rarely. Arguably, most canned foods are 'bland' because of their easy assimilation, while dry foods may be less suitable [5[201]]. Many clinicians advocate switching to a diet containing a novel protein source, given concerns in

humans that food allergies can develop to proteins eaten during a bout of acute gastroenteritis and delay recovery [2b[209]]. However, no similar evidence is available in cats. Although a reaction to the novel ingredient could occur, adverse reactions to foodstuffs not typically part of the normal diet (eg, poultry meat) may be easier to manage than for a constituent of a commercially available pet food [OEG D].

Gastric emptying is slower for foods with greater fat content, so fat restriction is commonly advocated. That said, the response in cats with chronic gastrointestinal signs is similar when using diets of differing fat content [2b[210]]. Diets with greater liquid content also empty faster: fully-liquid diets are quickest, followed by canned food, and dry kibbled diets are slowest [5[202]]. Finally, fibre content may also influence emptying [5[202]]. The feline stomach is less distensible than that of other species as their alimentary tracts are adapted to small, frequent meals [5[202]]. As a result, large-volume meals may provoke further vomiting. Taken together, this would suggest that a moderately energy dense, low fibre, wet (or liquid) diet should be used in small meals frequently [5[202]]. However, there has been no critical appraisal of this advice [OEG D].

Adverse reactions to food are reportedly a common cause of chronic gastrointestinal signs, including vomiting [2b[28,30]], with at least 50% of such cases responding when a diet based on novel ingredients is fed [2b[28]]. Some have suggested favourable responses when using hydrolysed protein diets [4c[29]], but no controlled studies exist. Nonetheless, favourable results were reported in a recent controlled trial assessing efficacy of hydrolysed protein diets for management of canine chronic enteropathy [2b[211]] [OEG B].

In contrast to stable acute vomiting cases with self-limiting disease, nutritional requirements for hospitalised cats are different, and withholding food is not usually recommended. In humans, enteral feeding methods are superior to parenteral nutrition in critically ill patients [1b[212]]. Such an approach improves survival, decreases infection rate, decreases bacterial translocation, has fewer complications and enables earlier discharge from hospital. There may be similar benefits in dogs, with experimental studies suggesting advantages of enteral nutrition over parenteral nutrition in a model of acute pancreatitis [2b[213,214]]. These findings are supported by two randomised controlled clinical studies comparing the efficacy of enteral nutrition in severe cases of gastroenteritis [2b[215,216]]. By extrapolation such strategies may be preferable in sick vomiting cats and may also reduce the likelihood of hepatic lipidosis [2b[206–208]] [OEG B].

A number of studies have provided information on the methods, applications and benefits of enteral nutrition [4a[217], 4b[218]]. Further, complications are well established, with vomiting being a prominent side effect [4a[218,219]]. There are also two experimental studies in cats assessing the benefits of enteral nutrition in cats given methotrexate chemotherapy [2b[221,222]]. These studies concluded that feeding a complex diet, containing intact protein as the nitrogen source, was preferable to the use of 'elemental' diets containing free amino acids as the only nitrogen source. While these findings may be most relevant to cats receiving chemotherapy, the conclusions may be pertinent to cats with other gastrointestinal disorders [OEG C].

In conclusion, limited information is available on appropriate nutritional management of vomiting cats. For those requiring hospitalisation, published studies in other species support the use of early enteral feeding. Enteral nutrition would also be favoured in cats with severe acute pancreatitis, although the only veterinary data would suggest that jejunostomy tube feeding is suitable. There is no direct evidence to support or refute the use of early enteral feeding in acutely vomiting cats that are managed as outpatients.

Monitoring

There are no published studies specifically addressing the most appropriate methods for monitoring vomiting cats. Most case series and reviews mentioning monitoring recommend using techniques appropriate to the underlying disease, including frequent clinical assessment during hospitalisation (especially postoperatively) [4b[53,163], 4c[223], 4d[224,225]], laboratory investigations [4a[226,227]], [4a[226,227], 4b[155], 4d[64,228]], indirect blood pressure measurement [4b[229]], and diagnostic imaging [5[230,231]] [OEG C].

The optimal timeframe for reassessment has also not been addressed specifically; when symptomatic treatment is administered to a vomiting cat suspected to have self-limiting disease, an initial maximum of 24 h antiemetic treatment is the usual recommendation. If vomiting continues beyond this time, if other signs have not improved, or if new signs are evident (eg, deterioration in appetite or general demeanour, or appearance of diarrhoea), we recommend that reassessment should occur no more than 48 h after the first visit. Owners should be warned that the use of an antiemetic drug can mask signs of vomiting associated with an underlying disease and should be asked to return sooner if there is no improvement or there is any clinical deterioration. At revisit, the cat should be reassessed for criteria that may necessitate further assessment or management (Table 7), and further treatment and investigations should be performed as appropriate (see above) [OEG D].

Vomiting in cats with cancer

Cats with benign or malignant tumours may vomit because of the presence of the tumour (eg, in the alimentary tract [4b[46,127,142,164], 4c[126,128,131,145,165], 4d[86,143,157,232–234]]; in the hepatobiliary system [4b[53,55], 4c[61]]; affecting the pancreas [4c[150]], or present systemically [4c[87], 4d[84–86]]) or

because of paraneoplastic effects [4c[235], 4d[149,228,236–238]] [OEG B].

Cancer chemotherapy also is associated with vomiting and nausea in cats, and can lead to adverse consequences, including anorexia [2b[239], 4b[240]]. Data from other species suggest that some anticancer drugs are more likely to cause vomiting than others [3a[2,241]], but similar data are not available for the cat. Anticancer drugs that have been associated with vomiting in tumour-bearing cats include cyclophosphamide [2b[242]] ifosfamide (vomiting was mild and self-limiting) [2b[243,244]], doxorubicin [2b[245,246]], methotrexate [2b[221,222]], vincristine/cyclophosphamide combined [4b[247]], mitoxantrone [4b[240]], idarubicin [4b[248]], chlorambucil (NB, treated cats had alimentary lymphoma) [4c[128]] and vincristine [5[249]]. Vomiting occurred in 16% of cats receiving piroxicam, more often when the cat was also receiving cancer chemotherapy, particularly doxorubicin or carboplatin [4a[250]]. However, carboplatin did not cause vomiting in nine healthy cats [3b[239]]. Cisplatin is used frequently in experimental emesis research and causes vomiting in cats [2b[178,251]], associated with serotonin release from the intestine [2b[252]], but the mechanism of cisplatin-induced vomiting in the cat may be different to other species [2b[14]]. Cisplatin is not used clinically in cats because of extreme toxicity in this species [2b[178,251]] [OEG B].

There are no published studies of antiemetic use in tumour-bearing cats receiving cancer chemotherapy. Some antiemetics that have been evaluated for protecting against chemotherapy-induced vomiting are not likely to be useful in the clinic [2b[187,190-192]]. $5HT_3$ antagonists have shown some efficacy against cisplatin-induced vomiting in the cat [2b[178,180]], but, as mentioned above, this is not directly relevant to chemotherapy in the cat because cisplatin should not be used. Anecdotally, dolasetron combined with metoclopramide could reduce the emetic potential of many drugs [5[179]] [OEG D]. While maropitant has demonstrated efficacy in preventing and treating nausea and vomiting induced by cisplatin in dogs,[254] there is no available evidence in cats.

Discussion

The current study is the first to attempt a comprehensive review the available evidence for causes, consequences, diagnosis and management of vomiting in the cat. The main aim of such a systematic review was, as far as possible, to present the available published evidence without prejudice or bias. For instance, it was necessary to report all the conditions where the published evidence suggests that it is a clinical sign. This can be helpful as it emphasises the necessity for keeping an open mind when investigating cats with signs of vomiting. Nonetheless, it is accepted that many clinicians may have their own opinions as to the validity of some of the reported associations. In this respect, the pathogenetic mechanisms for many of the conditions listed may not be clear and associations may actually be indirect (eg, disease A causes condition B which causes the vomiting). As a result, we have also attempted to highlight the most important causes of vomiting, especially those conditions that are especially important in cats. Such information represents our opinion, albeit after detailed review of the available literature and, thus, should be considered cautiously. It is possible that such information will need to be revised should new information become available in the future. In a similar manner, a wide array of diagnostic tests has been reported in the literature, yet many are uncommonly used in clinical practice owing to cost, availability or the fact that they have been superseded by better techniques. Again, therefore, we have highlighted those tests that we think to be of most use, based upon current knowledge, but recognise that opinions may change in time.

As is the case with many systematic reviews, a key study finding is that, despite the availability of numerous relevant publications, much of the evidence is weak (eg, LOE 4 or weaker, OEG C or D). The main exception is the information available on the emetic reflex in cats, largely as a result of the fact that much of the fundamental physiological knowledge has been derived from work in this species. While the relative dearth of more robust evidence, in other areas of the review, does not mean that the data available are invalid, it highlights the limit to our current knowledge and the need for further studies to be performed at more robust evidence levels. In our opinion, many areas require further study, including the need to clarify which historical and physical examination findings are most useful in determining the need for further intervention, and which novel tests will be of use for vomiting cases. However, most important is the need for more objective clinical evidence on the efficacy of the various treatments for vomiting in cats, including the potential benefits of nutritional support, antiemetic drugs and ancillary therapies. This last area is likely to provide the greatest benefit to feline patients.

One limitation of the study is the methodology used, namely limiting the information reported to that identified on literature searches using terms to describe vomiting (eg, vomit, emesis, antiemetic, etc). Although this enables much of the relevant literature to be identified, we recognise that some publications may be missed, for instance if they did not mention a relevant term in the title, abstract or keywords. Nonetheless, arguably, limiting the review in such a way ensures that the most relevant articles are used, as the vomiting is more likely to be a significant part of the disease condition reported. Such missing information is better identified by performing further evidence-based reviews but from the perspective of specific conditions. These approaches are

complementary and would be the best way to ensure that no gaps in knowledge are left.

Conclusions

This systematic review of the literature relating to causes, diagnosis and management of vomiting in cats has identified and summarised a large body of information. This review highlights the unfortunate fact that much of what we consider standard practice for cats is based on limited scientific evidence, on evidence extrapolated from other species or on expert opinion alone. Nonetheless, in some areas good evidence does exist, most notably concerning the mechanisms of vomiting. It is hoped that further research will improve knowledge in other areas, most notably concerning therapy for vomiting cats.

Acknowledgements We would like to acknowledge the help and support of Pfizer Animal Health. AJG's senior lectureship is supported by Royal Canin. The individual author contributions are as follows: DJB performed literature searches and collated information, drafted the initial manuscript, and reviewed and revised the manuscript for submission; PD and JE were involved in planning discussions and reviewed the manuscript; CME, VF, MG, EJH, EdH, DP and XR were involved in planning discussions, contributed to initial draft and reviewed the manuscript; RN was involved in planning discussions and reviewed the manuscript; KSB reviewed the manuscript; AJG was involved in planning discussions, contributed to initial draft, and reviewed and revised the manuscript for submission.

Funding Pfizer Animal Health provided financial support to cover the costs of performing the initial literature searches.

Conflicts of interest The European Emesis Council is supported financially by Pfizer Animal Health, the manufacturers of maropitant. One of the authors (KB) is an employee of Pfizer Animal Health, who was involved in reviewing the manuscript prior to submission. However, while comments could be made on the article content, Pfizer Animal Health were not allowed to draft or review the 'antiemetic therapy' section, could not prevent information from being included and could not prevent the work from being submitted for publication.

References

1 Lund EM, Armstrong PJ, Kirk CA, et al. **Health status and population characteristics of dogs and cats examined at private veterinary practices in the United States**. *J Am Vet Med Assoc* 1999; 214: 1336–1341.
2 Elwood C, Devauchelle P, Elliott J, et al. **Emesis in dogs: a review**. *J Small Anim Pract* 2010; 51: 4–22.
3 McCarthy LE and Borison HL. **Respiratory mechanics of vomiting in decerebrate cats**. *Am J Physiol* 1974; 226: 738–743.
4 Miller AD, Lakos SF and Tan LK. **Central motor program for relaxation of periesophageal diaphragm during the expulsive phase of vomiting**. *Brain Res* 1988; 456: 367–370.
5 Umezaki T, Shiba K, Zheng Y, et al. **Upper airway motor outputs during vomiting versus swallowing in the decerebrate cat**. *Brain Res* 1998; 19; 781: 25–36.
6 Miller AD. **Central mechanisms of vomiting**. *Dig Dis Sci* 1999; 44: 39S–43S.
7 Weisbrodt NW and Christensen J. **Electrical activity of the cat duodenum in fasting and vomiting**. *Gastroenterology* 1972; 63: 1004–1010.
8 Abrahamsson H and Thoren P. **Vomiting and reflex vagal relaxation of the stomach elicited from heart receptors in the cat**. *Acta Physiol Scand* 1973; 88: 433–439.
9 Grelot L, Barillot JC and Bianchi AL. **Activity of respiratory-related oropharyngeal and laryngeal motoneurones during fictive vomiting in the decerebrate cat**. *Brain Res* 1990; 513: 101–105.
10 Grelot L, Milano S, Portillo F, et al. **Membrane potential changes of phrenic motoneurons during fictive vomiting, coughing, and swallowing in the decerebrate cat**. *J Neurophysiol* 1992; 68: 2110–2119.
11 Umezaki T, Nakazawa K and Miller AD. **Behaviors of hypoglossal hyoid motoneurons in laryngeal and vestibular reflexes and in deglutition and emesis**. *Am J Physiol* 1998; 274: R950–R955.
12 Lang IM, Sarna SK and Shaker R. **Gastrointestinal motor and myoelectric correlates of motion sickness**. *Am J Physiol* 1999; 277: G642–G652.
13 Hornby P. **Central neurocircuitry associated with emesis**. *Am J Med* 2001; 111: 106S–12S.
14 Miller AD and Nonaka S. **Mechanisms of vomiting induced by serotonin-3 receptor agonists in the cat: effect of vagotomy, splanchnicectomy or area postrema lesion**. *J Pharmacol Exp Ther* 1992; 260: 509–517.
15 Borison HL and Goodheart ML. **Neural factors in acute emetic, cardiovascular, and respiratory effects of T-2 toxin in cats**. *Toxicol Appl Pharmacol* 1989; 101: 399–413.
16 Jovanovic-Micic D, Strbac M, Krstic SK, et al. **Ablation of the area postrema and emesis**. *Metab Brain Dis* 1989; 4: 55–60.
17 King GL. **Animal models in the study of vomiting**. *Can J Physiol Pharmacol* 1990; 68: 260–268.
18 Miller AD, Nonaka S and Jakus J. **Brain areas essential or non-essential for emesis**. *Brain Res* 1994; 647: 255–264.
19 Miller AD and Ruggiero DA. **Emetic reflex arc revealed by expression of the immediate-early gene c-fos in the cat**. *J Neurosci* 1994; 14: 871–888.
20 Lucot JB, Crampton GH, Matson WR, et al. **Cerebrospinal fluid constituents of cat vary with susceptibility to motion sickness**. *Life Sci* 1989; 44: 1239–1245.
21 Lucot JB and Crampton GH. **Xylazine emesis, yohimbine and motion sickness susceptibility in the cat**. *J Pharmacol Exp Ther* 1986; 237: 450–455.
22 Borison HL and Borison R. **Motion sickness reflex arc bypasses the area postrema in cats**. *Exp Neurol* 1986; 92: 723–737.
23 Miller AD and Leslie RA. **The area postrema and vomiting**. *Front Neuroendocrinol* 1994; 15: 301–320.
24 Miller AD and Wilson VJ. **'Vomiting center' reanalyzed: an electrical stimulation study**. *Brain Res* 1983; 270: 154–158.
25 Yuan CS and Barber WD. **Area postrema: gastric vagal input from proximal stomach and interactions with**

nucleus tractus solitarius in the cat. *Brain Res Bull* 1993; 30: 119–125.
26 Yates BJ, Grelot L, Kerman IA, et al. **Organization of vestibular inputs to nucleus tractus solitarius and adjacent structures in cat brain stem**. *Am J Physiol* 1994; 267: R974–R983.
27 Miller AD, Umezaki T, Nakazawa K, et al. **Recovery of retching after lesions involving the nucleus of the solitary tract**. *Neurosci Res* 1998; 31: 77–80.
28 Guilford WG, Markwell PJ, Jones BR, et al. **Prevalence and causes of food sensitivity in cats with chronic pruritus, vomiting or diarrhea**. *J Nutr* 1998; 128: 2790S–2791S.
29 Mandigers PJ, Biourge V and German AJ. **Efficacy of a commercial hydrolysate diet in eight cats suffering from inflammatory bowel disease or adverse reaction to food**. *Tijdschr Diergeneeskd* 2010; 135: 668–672.
30 Guilford WG, Jones BR, Markwell PJ, et al. **Food sensitivity in cats with chronic idiopathic gastrointestinal problems**. *J Vet Intern Med* 2001; 15: 7–13.
31 Hirt R and Iben C. **Possible food allergy in a colony of cats**. *J Nutr* 1998; 128: 2792S–2794S.
32 Guaguere E. **Food intolerance in cats with cutaneous manifestations: a review of 17 cases**. *J Vet All Clin Immunol* 1996; 4: 90–98.
33 el-Sanousi SM, el-Shazly MO, al-Dughyem A, et al. **An outbreak of enterotoxaemia in cats**. *Zentralbl Veterinarmed B* 1992; 39: 403–409.
34 Addie DD, Jarrett O, Simpson J, et al. **Feline parvovirus in pedigree kittens**. *Vet Rec* 1996; 138: 119.
35 Oliveira FN, Raffi MB, Souza TM, et al. **Feline infectious peritonitis: 13 cases**. *Ciência Rural* 2003; 33: 905–11.
36 Barrs VR, Beatty JA, Tisdall PL, et al. **Intestinal obstruction by trichobezoars in five cats**. *J Feline Med Surg* 1999; 1: 199–207.
37 Felts JF, Fox PR and Burk RL. **Thread and sewing needles as gastrointestinal foreign bodies in the cat: a review of 64 cases**. *J Am Vet Med Assoc* 1984; 184: 56–59.
38 Peppler C, Amort K, Thiel C, et al. **Linear foreign body as a cause of ileus in cats — incidence, diagnosis and treatment**. *Tierarztl Prax* 2008; 36: 437–442.
39 Colby ED, McCarthy LE and Borison HL. **Emetic action of xylazine on the chemoreceptor trigger zone for vomiting in cats**. *J Vet Pharmacol Ther* 1981; 4: 93–96.
40 Kolahian S and Jarolmasjed S. **Effects of metoclopramide on emesis in cats sedated with xylazine hydrochloride**. *J Feline Med Surg* 2010; 12: 899–903.
41 Ho CM, Ho ST, Wang JJ, et al. **Effects of dexamethasone on emesis in cats sedated with xylazine hydrochloride**. *Am J Vet Res* 2001; 62: 1218–1221.
42 Granholm M, McKusick BC, Westerholm FC, et al. **Evaluation of the clinical efficacy and safety of dexmedetomidine or medetomidine in cats and their reversal with atipamezole**. *Vet Anaesth Analg* 2006; 33: 214–223.
43 Vaha-Vahe T. **Clinical evaluation of medetomidine, a novel sedative and analgesic drug for dogs and cats**. *Acta Vet Scand* 1989; 30: 267–273.
44 Hart JR, Shaker E, Patnaik AK, et al. **Lymphocytic-plasmacytic enterocolitis in cats: 60 cases (1988–1990)**. *J Am Anim Hosp Assoc* 1994; 30: 505–514.
45 Waly NE, Stokes CR, Gruffydd-Jones TJ, et al. **Immune cell populations in the duodenal mucosa of cats with inflammatory bowel disease**. *J Vet Intern Med* 2004; 18: 816–825.
46 Waly NE, Gruffydd-Jones TJ, Stokes CR, et al. **Immunohistochemical diagnosis of alimentary lymphomas and severe intestinal inflammation in cats**. *J Comp Pathol* 2005; 133: 253–260.
47 Jergens AE, Moore FM, Haynes JS, et al. **Idiopathic inflammatory bowel disease in dogs and cats: 84 cases (1987–1990)**. *J Am Vet Med Assoc* 1992; 201: 1603–1608.
48 Dennis JS, Kruger JM and Mullaney TP. **Lymphocytic/plasmacytic gastroenteritis in cats: 14 cases (1985–1990)**. *J Am Vet Med Assoc* 1992; 200: 1712–1718.
49 Kleinschmidt S, Nolte I and Hewicker-Trautwein M. **Structural and functional changes of neuronal and glial components of the feline enteric nervous system in cats with chronic inflammatory and non-inflammatory diseases of the gastrointestinal tract**. *Res Vet Sci* 2011; 91: 129–135.
50 Center SA, Baldwin BH, King JM, et al. **Hematologic and biochemical abnormalities associated with induced extrahepatic bile duct obstruction in the cat**. *Am J Vet Res* 1983; 44: 1822–1829.
51 Center SA, Crawford MA, Guida L, et al. **A retrospective study of 77 cats with severe hepatic lipidosis: 1975–1990**. *J Vet Intern Med* 1993; 7: 349–359.
52 Bielsa LM and Greiner EC. **Liver flukes (*Platynosomum concinnum*) in cats**. *J Am Anim Hosp Assoc* 1985; 21: 269–274.
53 Buote NJ, Mitchell SL, Penninck D, et al. **Cholecystoenterostomy for treatment of extrahepatic biliary tract obstruction in cats: 22 cases (1994–2003)**. *J Am Vet Med Assoc* 2006; 228: 1376–1382.
54 Mayhew PD, Holt DE, McLear RC, et al. **Pathogenesis and outcome of extrahepatic biliary obstruction in cats**. *J Small Anim Pract* 2002; 43: 247–253.
55 Lawrence HJ, Erb HN and Harvey HJ. **Non-lymphomatous hepatobiliary masses in cats: 41 cases (1972 to 1991)**. *Vet Surg* 1994; 23: 365–368.
56 Meertens NM, Bokhove CA and van den Ingh TS. **Copper-associated chronic hepatitis and cirrhosis in a European Shorthair cat**. *Vet Pathol* 2005; 42: 97–100.
57 Brain PH, Barrs VR, Martin P, et al. **Feline cholecystitis and acute neutrophilic cholangitis: clinical findings, bacterial isolates and response to treatment in six cases**. *J Feline Med Surg* 2006; 8: 91–103.
58 Shaker EH, Zawie DA, Garvey MS, et al. **Suppurative cholangiohepatitis in a cat**. *J Am Anim Hosp Assoc* 1991; 27: 148–150.
59 Fahie MA and Martin RA. **Extrahepatic biliary tract obstruction: a retrospective study of 45 cases (1983–1993)**. *J Am Anim Hosp Assoc* 1995; 31: 478–482.
60 Rallis T, Tontis D and Koutinas A. **Hepatic cysts in the cat: a case report**. *Bull Hellenic Vet Med Soc* 1991; 42: 197–200.
61 Patnaik AK, Lieberman PH, Erlandson RA, et al. **Hepatobiliary neuroendocrine carcinoma in cats: a clinicopathologic, immunohistochemical, and ultrastructural study of 17 cases**. *Vet Pathol* 2005; 42: 331–337.

62 Ilha MR, Loretti AP, Barros CSL, et al. **Biliary cirrhosis in cats associated with cystic duct ectasia and extra-hepatic portosystemic shunts**. *Ciência Rural* 2004; 34: 1147–1153.

63 Harvey AM, Holt PE, Barr FJ, et al. **Treatment and long-term follow-up of extrahepatic biliary obstruction with bilirubin cholelithiasis in a Somali cat with pyruvate kinase deficiency**. *J Feline Med Surg* 2007; 9: 424–431.

64 van Geffen C, Savary-Bataille K, Chiers K, et al. **Bilirubin cholelithiasis and haemosiderosis in an anaemic pyruvate kinase-deficient Somali cat**. *J Small Anim Pract* 2008; 49: 479–482.

65 Della Santa D, Schweighauser A, Forterre F, et al. **Imaging diagnosis — extrahepatic biliary tract obstruction secondary to a duodenal foreign body in a cat**. *Vet Radiol Ultrasound* 2007; 48: 448–450.

66 Proverbio D, Spada E, Faverzani S, et al. **Multiple hepatic vascular cysts in a young Ragdoll cat**. *Vet Rec* 2008; 163: 748–749.

67 Regnier A and Pieraggi MT. **Abnormal skin fragility in a cat with cholangiocarcinoma**. *J Small Anim Pract* 1989; 30: 419–423.

68 Filgueira KD, Reis PFC, Freitas VAL, et al. **Cholangiocarcinoma in domestic feline: a case report**. *Revista MVZ Córdoba* 2009; 7: 113–116.

69 Bruner JM, Steiner JM, Williams DA, et al. **High feline trypsin-like immunoreactivity in a cat with pancreatitis and hepatic lipidosis**. *J Am Vet Med Assoc* 1997; 210: 1757–1760.

70 Hampson ECGM, Filippich LJ, Kelly WR, et al. **Congenital biliary atresia in a cat: a case report**. *J Small Anim Pract* 1987; 28: 39–48.

71 Finco DR and Cornelius LM. **Characterisation and treatment of water, electrolyte, and acid-base imbalances of induced urethral obstruction in the cat**. *Am J Vet Res* 1977; 38: 823–830.

72 DiBartola SP, Rutgers HC, Zack PM, et al. **Clinicopathologic findings associated with chronic renal disease in cats: 74 cases (1973–1984)**. *J Am Vet Med Assoc* 1987; 190: 1196–1202.

73 Elliott J and Barber PJ. **Feline chronic renal failure: clinical findings in 80 cases diagnosed between 1992 and 1995**. *J Small Anim Pract* 1998; 39: 78–85.

74 Pagas JP. **Nephropathies associated with NSAIDs in cats: 21 cases (1993–2001)**. *Prat Med Chir Anim* 2005; 40: 177–181.

75 Kuwahara Y, Ohba Y, Kitoh K, et al. **Association of laboratory data and death within one month in cats with chronic renal failure**. *J Small Anim Pract* 2006; 47: 446–450.

76 Dorval P and Boysen SR. **Management of acute renal failure in cats using peritoneal dialysis: a retrospective study of six cases (2003–2007)**. *J Feline Med Surg* 2009; 11: 107–115.

77 Aresu L, Zanatta R, Pregel P, et al. **Bilateral juvenile renal dysplasia in a Norwegian Forest cat**. *J Feline Med Surg* 2009; 11: 326–329.

78 Volta A, Manfredi S, Gnudi G, et al. **Polycystic kidney disease in a Chartreux cat**. *J Feline Med Surg* 2010; 12: 138–140.

79 Thoday KL and Mooney CT. **Historical, clinical and laboratory features of 126 hyperthyroid cats**. *Vet Rec* 1992; 19; 131: 257–264.

80 Peterson ME, Kintzer PP, Cavanagh PG, et al. **Feline hyperthyroidism: pretreatment clinical and laboratory evaluation of 131 cases**. *J Am Vet Med Assoc* 1983; 183: 103–110.

81 Rossmeisl JH, Jr, Scott-Moncrieff JC, Siems J, et al. **Hyperadrenocorticism and hyperprogesteronaemia in a cat with an adrenocortical adenocarcinoma**. *J Am Anim Hosp Assoc* 2000; 36: 512–517.

82 Raffan E, Kipar A, Barber PJ, et al. **Transitional cell carcinoma forming a perirenal cyst in a cat**. *J Small Anim Pract* 2006; 49: 144–147.

83 Nakamoto Y, Yoshikawa H, Ozawa T, et al. **Renal and intrathoracic hemangiosarcoma in a cat**. *J Japan Vet Med Assoc* 2008; 61: 377–381.

84 Sharifi H, Nassiri SM, Esmaelli H, et al. **Eosinophilic leukaemia in a cat**. *J Feline Med Surg* 2007; 9: 514–517.

85 Tebb AJ, Cave T, Barron R, et al. **Diagnosis and management of B cell chronic lymphocytic leukaemia in a cat**. *Vet Rec* 2004; 154: 430–433.

86 Reed N, Begara-McGorum IM, Else RW, et al. **Unusual histiocytic disease in a Somali cat**. *J Feline Med Surg* 2006; 8: 129–134.

87 Takeuchi Y, Matsuura S, Fujino Y, et al. **Hypereosinophilic syndrome in two cats**. *J Vet Med Sci* 2008; 70: 1085–1089.

88 Muir P, Gruffydd-Jones TJ and Brown PJ. **Hypereosinophilic syndrome in a cat**. *Vet Rec* 1993; 132: 358–359.

89 Backlund B, Cianciolo RE, Cook AK, et al. **Minimal change glomerulopathy in a cat**. *J Feline Med Surg* 2011; 13: 291–295.

90 Haynes SM, Hodge PJ, Lording P, et al. **Use of prednisolone and cyclosporin to manage idiopathic hypereosinophilic syndrome in a cat**. *Aust Vet Pract* 2011; 41: 76–81.

91 Ottenjann M, Kohn B, Weingart C, et al. **Ruptured splenic hemangiosarcoma causing hemoperitoneum in 4 cats**. *Kleintierpraxis* 2003; 48: 345–348.

92 Culp WT and Aronson LR. **Splenic foreign body in a cat**. *J Feline Med Surg* 2008; 10: 380–383.

93 Schorr-Evans EM, Poland A, Johnson WE, et al. **An epizootic of highly virulent feline calicivirus disease in a hospital setting in New England**. *J Feline Med Surg* 2003; 5: 217–226.

94 Reynolds BS, Poulet H, Pingret J-L, et al. **A nosocomial outbreak of feline calicivirus associated virulent systemic disease in France**. *J Feline Med Surg* 2009; 11: 633–644.

95 Shimoda T, Shiranaga N, Mashita T, et al. **Bone marrow necrosis in a cat infected with feline leukemia virus**. *J Vet Med Sci* 2000; 62: 113–115.

96 Yamamoto JK, Hansen H, Ho EW, et al. **Epidemiological and clinical aspects of feline immunodeficiency virus infection in cats from the continental United States and Canada and possible mode of transmission**. *J Am Vet Med Assoc* 1989; 194: 213–220.

97 Baral R, Metcalfe SS, Krockenberger M, et al. **Disseminated *Mycobacterium avium* infection in young cats: overrepresentation of Abyssinian cats**. *J Feline Med Surg* 2006; 8: 23–44.

98 Griffin A, Newton AL, Aronson LR, et al. **Disseminated *Mycobacterium avium* complex infection following renal transplantation in a cat**. *J Am Vet Med Assoc* 2003; 222: 1097–1098.

99 Latimer KS, Jameson PH, Crowell WA, et al. **Disseminated *Mycobacterium avium* complex infection in a cat: presumptive diagnosis by blood smear examination**. *Vet Clin Pathol* 1997; 26: 85–89.

100 Riviere D, Pingret JL, Etievant M, et al. **Disseminated *Mycobacterium avium* subspecies infection in a cat**. *J Feline Med Surg* 2011; 13: 125–128.

101 Little L, Shokek A, Dubey JP, et al. ***Toxoplasma gondii*-like organisms in skin aspirates from a cat with disseminated protozoal infection**. *Vet Clin Pathol* 2005; 34: 156–160.

102 Spycher A, Geigy C, Howard J, et al. **Isolation and genotyping of *Toxoplasma gondii* causing fatal systemic toxoplasmosis in an immunocompetent 10-year-old cat**. *J Vet Diagn Invest* 2011; 23: 104–108.

103 Tarello W. **Microscopic and clinical evidence for *Anaplasma (Ehrlichia) phagocytophilum* infection in Italian cats**. *Vet Rec* 2005; 156: 772–774.

104 Da Silva AS, Pierezan F, Wolkmer P, et al. **Pathological findings associated with experimental infection by *Trypanosoma evansi* in cats**. *J Comp Pathol* 2010; 142: 170–176.

105 Woods JP, Crystal MA, Morton RJ, et al. **Tularemia in two cats**. *J Am Vet Med Assoc* 1998; 212: 81–83.

106 Beaufils JP, Martin-Granel J, Jumelle P, et al. **Ehrlichiosis in cats. A retrospective study of 21 cases**. *Prat Méd Chir Anim* 1999; 34: 587–596.

107 Varshney JP, Deshmukh VV and Chaudhary PS. **Clinical ehrlichiosis in a kitten**. *Intas Polivet* 2009; 10: 394–396.

108 Kobayashi R, Tanaka F, Asai A, et al. **First case report of histoplasmosis in a cat in Japan**. *J Vet Med Sci* 2009; 71: 1669–1672.

109 Mavropoulou A, Grandi G, Calvi L, et al. **Disseminated histoplasmosis in a cat in Europe**. *J Small Anim Pract* 2010; 51: 176–180.

110 Mordecai A, Liptak JM, Hofstede T, et al. **Prostatic abscess in a neutered cat**. *J Am Anim Hosp Assoc* 2008; 44: 90–94.

111 Demko JL and Cohn LA. **Chronic nasal discharge in cats: 75 cases (1993–2004)**. *J Am Vet Med Assoc* 2007; 230: 1032–1037.

112 Barrs VR, Allan GS, Martin P, et al. **Feline pyothorax: a retrospective study of 27 cases in Australia**. *J Feline Med Surg* 2005; 7: 211–222.

113 Schoeman JP. **Feline distal aortic thromboembolism: a review of 44 cases (1990–1998)**. *J Feline Med Surg* 1999; 1: 221–231.

114 Kim M, Lee H, Kim J, et al. **Hypertrophic cardiomyopathy with aortic thromboembolism in two cats**. *J Vet Clin* 2009; 26: 362–366.

115 Moise NS, Wiedenkeller D, Yeager AE, et al. **Clinical, radiographic, and bronchial cytologic features of cats with bronchial disease: 65 cases (1980–1986)**. *J Am Vet Med Assoc* 1989; 194: 1467–1473.

116 Simard MJ and Dubé PG. **Feline asthma**. *Médicin Vétérinaire de Québec* 1992; 22: 129.

117 Jergens AE, Pressel M, Crandell J, et al. **Fluorescence in situ hybridization confirms clearance of visible *Helicobacter* spp associated with gastritis in dogs and cats**. *J Vet Intern Med* 2009; 23: 16–23.

118 Takemura LS, Camargo PL, Alfieri AA, et al. ***Helicobacter* spp in cats: association between infecting species and epithelial proliferation within the gastric lamina propria**. *J Comp Pathol* 2009; 141: 127–134.

119 Kershaw O, Deppenmeier S and Gruber AD. **Multiple cystic intestinal duplications in a cat**. *Vet Pathol* 2008; 45: 188–190.

120 Burkitt JM, Drobatz KJ, Saunders HM, et al. **Signalment, history, and outcome of cats with gastrointestinal tract intussusception: 20 cases (1986–2000)**. *J Am Vet Med Assoc* 2009; 234: 771–776.

121 Bellenger CR and Beck JA. **Intussusception in 12 cats**. *J Small Anim Pract* 1994; 35: 295–298.

122 Carpenter JL. **Feline panleukopenia: clinical signs and differential diagnosis**. *J Am Vet Med Assoc* 1971; 158: 857–859.

123 Tzannes S, Batchelor DJ, Graham PA, et al. **Prevalence of *Cryptosporidium, Giardia* and *Isospora* species infections in pet cats with clinical signs of gastrointestinal disease**. *J Feline Med Surg* 2008; 10: 1–8.

124 Vasilopulos RJ, Mackin AJ, Rickard LG, et al. **Prevalence and factors associated with fecal shedding of *Giardia* spp in domestic cats**. *J Am Anim Hosp Assoc* 2006; 42: 424–429.

125 Kipar A, Kremendahl J, Addie DD, et al. **Fatal enteritis associated with coronavirus infection in cats**. *J Comp Pathol* 1998; 119: 1–14.

126 Cribb AE. **Feline gastrointestinal adenocarcinoma: a review and retrospective study**. *Can Vet J* 1988; 29: 709–712.

127 Kiselow MA, Rassnick KM, McDonough SP, et al. **Outcome of cats with low-grade lymphocytic lymphoma: 41 cases (1995–2005)**. *J Am Vet Med Assoc* 2008; 232: 405–410.

128 Lingard AE, Briscoe K, Beatty JA, et al. **Low-grade alimentary lymphoma: clinicopathological findings and response to treatment in 17 cases**. *J Feline Med Surg* 2009; 11: 692–700.

129 Twaddle AA. **Pyloric stenosis in three cats and its correction by pyloroplasty**. *N Z Vet J* 1970; 18: 15–17.

130 Twaddle AA. **Congenital pyloric stenosis in two kittens corrected by pyloroplasty**. *N Z Vet J* 1971; 19: 26–27.

131 MacDonald JM, Mullen HS and Moroff SD. **Adenomatous polyps of the duodenum in cats: 18 cases (1985–1990)**. *J Am Vet Med Assoc* 1993; 202: 647–651.

132 Chang J, Jung JH, Yoon J, et al. **Segmental aplasia of the uterine horn with ipsilateral renal agenesis in a cat**. *J Vet Med Sci* 2008; 70: 641–643.

133 Bulman-Fleming J. **A rare case of uterine adenomyosis in a Siamese cat**. *Can Vet J* 2008; 49: 709–712.

134 LeRoy BE and Lech ME. **Prostatic carcinoma causing urethral obstruction and obstipation in a cat**. *J Feline Med Surg* 2004; 6: 397–400.

135 Frowde PE, Battersby IA, Whitley NT, et al. **Oesophageal disease in 33 cats**. *J Feline Med Surg* 2011; 13: 564–569.

136 Gualtieri M and Olivero D. **Reflux esophagitis in three cats associated with metaplastic columnar esophageal epithelium**. *J Am Anim Hosp Assoc* 2006; 42: 65–70.

137 van Geffen C, Saunders JH, Vandevelde B, et al. **Idiopathic megaoesophagus and intermittent gastro-oesophageal intussusception in a cat**. *J Small Anim Pract* 2006; 47: 471–475.

138 Martinez NI, Cook W, Troy GC, et al. **Intermittent gastroesophageal intussusception in a cat with idiopathic megaesophagus**. *J Am Anim Hosp Assoc* 2001; 37: 234–237.

139 Peterson SL. **Esophageal hiatal hernia in a cat**. *J Am Vet Med Assoc* 1983; 183: 325–326.

140 el-Sanousi SM, el-Shazly MO, al-Dughyem A, et al. **An outbreak of enterotoxaemia in cats**. *Zentralbl Veterinarmed B* 1992; 39: 403–409.

141 Huang-Kornic E. **Chronic intermittent vomiting in a cat: a case of chronic lymphocytic-plasmacytic gastritis**. *Can Vet J* 1999; 40: 196–198.

142 Kosovsky JE, Matthiesen DT and Patnaik AK. **Small intestinal adenocarcinoma in cats: 32 cases (1978–1985)**. *J Am Vet Med Assoc* 1988; 192: 233–235.

143 Rossmeisl JH Jr, Forrester SD, Robertson JL, et al. **Chronic vomiting associated with a gastric carcinoid in a cat**. *J Am Anim Hosp Assoc* 2002; 38: 61–66.

144 McPherron MA, Chavkin MJ, Powers BE, et al. **Globule leukocyte tumor involving the small intestine in a cat**. *J Am Vet Med Assoc* 1994; 204: 241–245.

145 Dennis MM, Bennett N and Ehrhart EJ. **Gastric adenocarcinoma and chronic gastritis in two related Persian cats**. *Vet Pathol* 2006; 43: 358–362.

146 Gustafson BW. **Ivermectin in the treatment of *Physaloptera preputialis* in two cats**. *J Am Anim Hosp Assoc* 1995; 31: 416–418.

147 Crenshaw KL and Peterson ME. **Pretreatment clinical and laboratory evaluation of cats with diabetes mellitus: 104 cases (1992–1994)**. *J Am Vet Med Assoc* 1996; 209: 943–949.

148 Zulauf D, Voss K and Reichler IM. **Herniation of the urinary bladder through a congenitally enlarged inguinal canal in a cat**. *Schweiz Arch Tierheilkd* 2007; 149: 559–562.

149 Marquez GA, Klausner JS and Osborne CA. **Calcium oxalate urolithiasis in a cat with a functional parathyroid adenocarcinoma**. *J Am Vet Med Assoc* 1995; 206: 817–819.

150 Seaman RL. **Exocrine pancreatic neoplasia in the cat: a case series**. *J Am Anim Hosp Assoc* 2004; 40: 238–245.

151 Barrs VR, Beatty JA, McCandlish IA, et al. **Hypereosinophilic paraneoplastic syndrome in a cat with intestinal T cell lymphosarcoma**. *J Small Anim Pract* 2002; 43: 401–405.

152 Coleman MG, Robson MC and Harvey C. **Pancreatic cyst in a cat**. *N Z Vet J* 2005; 53: 157–159.

153 Kitchell BE, Strombeck DR, Cullen J, et al. **Clinical and pathologic changes in experimentally induced acute pancreatitis in cats**. *Am J Vet Res* 1986; 47: 1170–1173.

154 Steiner JM and Williams DA. **Feline exocrine pancreatic disorders**. *Vet Clin North Am Small Anim Pract* 1999; 29: 551–575.

155 Parsons KJ, Owen LJ, Lee K, et al. **A retrospective study of surgically treated cases of septic peritonitis in the cat (2000–2007)**. *J Small Anim Pract* 2009; 50: 518–524.

156 Liptak JM, Hunt GB, Barrs VR, et al. **Gastroduodenal ulceration in cats: eight cases and a review of the literature**. *J Feline Med Surg* 2002; 4: 27–42.

157 Stimson EL, Cook WT, Smith MM, et al. **Extraskeletal osteosarcoma in the duodenum of a cat**. *J Am Anim Hosp Assoc* 2000; 36: 332–336.

158 Daniel AG, Lucas SR, Junior AR, et al. **Skin fragility syndrome in a cat with cholangiohepatitis and hepatic lipidosis**. *J Feline Med Surg* 2010; 12: 151–155.

159 Eich CS and Ludwig LL. **The surgical treatment of cholelithiasis in cats: a study of nine cases**. *J Am Anim Hosp Assoc* 2002; 38: 290–296.

160 Aumann M, Worth LT and Drobatz KJ. **Uroperitoneum in cats: 26 cases (1986–1995)**. *J Am Anim Hosp Assoc* 1998; 34: 315–324.

161 Hardie EM, Rottman JB and Levy JK. **Sclerosing encapsulating peritonitis in four dogs and a cat**. *Vet Surg* 1994; 23: 107–114.

162 Culp WT, Weisse C, Kellogg ME, et al. **Spontaneous hemoperitoneum in cats: 65 cases (1994–2006)**. *J Am Vet Med Assoc* 2010; 236: 978–982.

163 Culp WT, Zeldis TE, Reese MS, et al. **Primary bacterial peritonitis in dogs and cats: 24 cases (1990–2006)**. *J Am Vet Med Assoc* 2009; 234: 906–913.

164 Mahony OM, Moore AS, Cotter SM, et al. **Alimentary lymphoma in cats: 28 cases (1988–1993)**. *J Am Vet Med Assoc* 1995; 207: 1593–1598.

165 Wellman ML, Hammer AS, DiBartola SP, et al. **Lymphoma involving large granular lymphocytes in cats: 11 cases (1982–1991)**. *J Am Vet Med Assoc* 1992; 201: 1265–1269.

166 MacPhail C. **Gastrointestinal obstruction**. *Clin Tech Small Anim Pract* 2002; 17: 178–183.

167 Scott KD, Zoran DL, Mansell J, et al. **Utility of endoscopic biopsies of the duodenum and ileum for diagnosis of inflammatory bowel disease and small cell lymphoma in cats**. *J Vet Intern Med* 2011; 25: 1253–1257.

168 Kleinschmidt S, Harder J, Nolte I, et al. **Chronic inflammatory and non-inflammatory diseases of the gastrointestinal tract in cats: diagnostic advantages of full-thickness intestinal and extraintestinal biopsies**. *J Feline Med Surg* 2010; 12: 97–103.

169 Parent C, Washabau RJ, Williams DA, et al. **Serum trypsin-like immunoreactivity, amylase and lipase in the diagnosis of feline acute pancreatitis**. *J Vet Intern Med* 1995; 9: 194.

170 Borison HL and WANG SC. **Physiology and pharmacology of vomiting**. *Pharmacol Rev* 1953; 5: 193–230.

171 Hikasa Y, Akiba T, Iino Y, et al. **Central alpha-adrenoceptor subtypes involved in the emetic pathway in cats**. *Eur J Pharmacol* 1992; 229: 241–251.

172 Hikasa Y, Takase K and Ogasawara S. **Evidence for the involvement of alpha 2-adrenoceptors in the emetic action of xylazine in cats**. *Am J Vet Res* 1989; 50: 1348–1351.

173 Jovanovic-Micic D, Samardzic R and Beleslin DB. **The role of alpha-adrenergic mechanisms within the area postrema in dopamine-induced emesis**. *Eur J Pharmacol* 1995; 272: 21–30.

174 Brand ED, Harris TD, Borison HL, et al. **The anti-emetic activity of 10-(gamma-dimethylaminopropyl)-2-chlorophenothiazine (chlorpromazine) in dog and cat**. *J Pharmacol Exp Ther* 1954; 110: 86–92.

175 Topal A and Gul N. **Effects of dexamethasone, metoclopramide or acepromazine on emesis in cats sedated with xylazine hydrochloride**. *Acta Vet Brno* 2006; 75: 299–303.

176 Mangel AW, Stavorski JR and Pendleton RG. **Effects of bethanechol, metoclopramide, and domperidone on antral contractions in cats and dogs**. *Digestion* 1983; 28: 205–209.

177 Hillemeier C, McCallum R, Oertel R, et al. **Effect of bethanechol and metoclopramide on upper gastrointestinal motility in the kitten**. *J Pediatr Gastroenterol Nutr* 1986; 5: 134–137.

178 Rudd JA, Tse JY and Wai MK. **Cisplatin-induced emesis in the cat: effect of granisetron and dexamethasone**. *Eur J Pharmacol* 2000; 391: 145–150.

179 Ogilvie GK. **Dolasetron: a new option for nausea and vomiting**. *J Am Anim Hosp Assoc* 2000; 36: 481–483.

180 Lucot JB. **Blockade of 5-hydroxytryptamine 3 receptors prevents cisplatin-induced but not motion- or xylazine-induced emesis in the cat**. *Pharmacol Biochem Behav* 1989; 32: 207–210.

181 Santos LC, Ludders JW, Erb HN, et al. **A randomized, blinded, controlled trial of the antiemetic effect of ondansetron on dexmedetomidine-induced emesis in cats**. *Vet Anaesth Analg* 2011; 38: 320–327.

182 Smith WL, Callaham EM and Alphin RS. **The emetic activity of centrally administered cisplatin in cats and its antagonism by zacopride**. *J Pharm Pharmacol* 1988; 40: 142–143.

183 Milano S, Grelot L, Chen Z, et al. **Vagal-induced vomiting in decerebrate cat is not suppressed by specific 5-HT$_3$ receptor antagonists**. *J Auton Nerv Syst* 1990; 31: 109–118.

184 Hickman MA, Cox SR, Mahabir S, et al. **Safety, pharmacokinetics and use of the novel NK-1 receptor antagonist maropitant (Cerenia) for the prevention of emesis and motion sickness in cats**. *J Vet Pharmacol Ther* 2008; 31: 220–229.

185 Lucot JB, Obach RS, McLean S, et al. **The effect of CP-99994 on the responses to provocative motion in the cat**. *Br J Pharmacol* 1997; 120: 116–120.

186 Lucot JB and Takeda N. **alpha-Fluoromethylhistidine but not diphenhydramine prevents motion-induced emesis in the cat**. *Am J Otolaryngol* 1992; 13: 176–180.

187 Lucot JB and Crampton GH. **Buspirone blocks motion sickness and xylazine-induced emesis in the cat**. *Aviat Space Environ Med* 1987; 58: 989–991.

188 Lucot JB and Crampton GH. **8-OH-DPAT suppresses vomiting in the cat elicited by motion, cisplatin or xylazine**. *Pharmacol Biochem Behav* 1989; 33: 627–631.

189 Lucot JB. **Effects of serotonin antagonists on motion sickness and its suppression by 8-OH-DPAT in cats**. *Pharmacol Biochem Behav* 1990; 37: 283–287.

190 Lucot JB. **Antiemetic effects of flesinoxan in cats: comparisons with 8-hydroxy-2-(di-n-propylamino)tetralin**. *Eur J Pharmacol* 1994; 253: 53–60.

191 Schmidt CD, Sata E, Brizzee KR, et al. **Effect of dimenhydrinate and diphenhydramine on apomorphine-induced emesis in dogs and cats**. *Proc Soc Exp Biol Med* 1953; 82: 441–444.

192 Costello DJ and Borison HL. **Naloxone antagonizes narcotic self blockade of emesis in the cat**. *J Pharmacol Exp Ther* 1977; 203: 222–230.

193 London SW, McCarthy LE and Borison HL. **Suppression of cancer chemotherapy-induced vomiting by nabilone, a synthetic cannabinoid (40465)**. *Proc Soc Exp Biol Med* 1979; 160: 437–440.

194 McCarthy LE and Borison HL. **Antiemetic activity of N-methyllevonantradol and nabilone in cisplatin-treated cats**. *J Clin Pharmacol* 1981; 21: 30S–37S.

195 Pei JS, Tong BL, Chen KJ, et al. **Experimental research on antimotion sickness effects of Chinese medicine 'pingandan' pills in cats**. *Chin Med J (Engl)* 1992; 105: 322–327.

196 Lucot JB. **Effects of N-methyl-D-aspartate antagonists on different measures of motion sickness in cats**. *Brain Res Bull* 1998; 47: 407–411.

197 Samardzic R, Bajcetic M and Beleslin DB. **Opposite effects of ethanol and nitrendipine on nicotine-induced emesis and convulsions**. *Alcohol* 1999; 18: 215–219.

198 Ho CM, Ho ST, Wang JJ, et al. **Dexamethasone has a central antiemetic mechanism in decerebrated cats**. *Anesth Analg* 2004; 99: 734–739.

199 Bosnjak S and Beleslin DB. **Emesis: antiemetic effect of cyclophosphamide at central receptors of multitransmitter system in the cat**. *Pharmacol Res* 2002; 46: 425–434.

200 Eyvazi H and Khodai H. **Effects of dexamethasone and metoclopramide on emesis in cats sedated with xylazine hydrochloride**. *Global Veterinaria* 2011; 7: 184–187.

201 Guilford WG and Matz ME. **The nutritional management of gastrointestinal tract disorders in companion animals**. *N Z Vet J* 2003; 51: 284–291.

202 Zoran DL. **Nutritional management of feline gastrointestinal diseases**. *Top Companion Anim Med* 2008; 23: 200–206.

203 Remillard RL and Thatcher CD. **Dietary and nutritional management of gastrointestinal diseases**. *Vet Clin North Am Small Anim Pract* 1989; 19: 797–816.

204 Marks SL and Fascetti AJ. **Nutritional management of diarrheal diseases**. In: Bonagura J (ed). Current veterinary therapy XIII. Philadelphia: WB Saunders, 2000, pp 653–658.

205 Sandhu BK. **Rationale for early feeding in childhood gastroenteritis**. *J Pediatr Gastroenterol Nutr* 2001; 33 (Suppl. 2): S13–S16.

206 Biourge V, Groff JM, Fisher C, et al. **Nitrogen balance, plasma free amino acid concentrations and urinary orotic acid excretion during long-term fasting in cats**. *J Nutr* 1994; 124: 1094–1103.

207 Biourge VC, Groff JM, Munn RJ, et al. **Experimental induction of hepatic lipidosis in cats**. *Am J Vet Res* 1994; 55: 1291–1302.

208 Szabo J, Ibrahim WH, Sunvold GD, et al. **Effect of dietary protein quality and essential fatty acids on fatty acid composition in the liver and adipose tissue after rapid weight loss in overweight cats**. *Am J Vet Res* 2003; 64: 310–315.

209 Iyngkaran N, Robinson MJ, Sumithran E, et al. **Cows' milk protein-sensitive enteropathy. An important factor in prolonging diarrhoea of acute infective enteritis in early infancy**. *Arch Dis Child* 1978; 53: 150–153.

210 Laflamme DP, Xu H and Long GM. **Effect of diets differing in fat content on chronic diarrhea in cats**. *J Vet Intern Med* 2011; 25: 230–235.

211 Mandigers PJ, Biourge V, van den Ingh TS, et al. **A randomized, open-label, positively-controlled field trial of a hydrolyzed protein diet in dogs with chronic small bowel enteropathy**. *J Vet Intern Med* 2010; 24: 1350–1357.

212 Zaloga GP. **Parenteral nutrition in adult inpatients with functioning gastrointestinal tracts: assessment of outcomes**. *Lancet* 2006; 367: 1101–1111.

213 Qin HL, Su ZD, Hu LG, et al. **Effect of early intrajejunal nutrition on pancreatic pathological features and gut barrier function in dogs with acute pancreatitis**. *Clin Nutr* 2002; 21: 469–473.

214 Xu GF, Lu Z, Gao J, et al. **Effect of ecoimmunonutrition supports on maintenance of integrity of intestinal mucosal**

barrier in severe acute pancreatitis in dogs. *Chin Med J (Engl)* 2006; 20: 656–661.
215 Mohr AJ, Leisewitz AL, Jacobson LS, et al. **Effect of early enteral nutrition on intestinal permeability, intestinal protein loss, and outcome in dogs with severe parvoviral enteritis**. *J Vet Intern Med* 2003; 17: 791–798.
216 Will K, Nolte I and Zentek J. **Early enteral nutrition in young dogs suffering from haemorrhagic gastroenteritis**. *J Vet Med A Physiol Pathol Clin Med* 2005; 52: 371–376.
217 Levine PB, Smallwood LJ and Buback JL. **Esophagostomy tubes as a method of nutritional management in cats: a retrospective study**. *J Am Anim Hosp Assoc* 1997; 33: 405–410.
218 Abood SK and Buffington CA. **Enteral feeding of dogs and cats: 51 cases (1989–1991)**. *J Am Vet Med Assoc* 1992; 201: 619–622.
219 Crowe DT, Jr., Devey J, Palmer DA, et al. **The use of polymeric liquid enteral diets for nutritional support in seriously ill or injured small animals: clinical results in 200 patients**. *J Am Anim Hosp Assoc* 1997; 33: 500–508.
220 Smith SA, Ludlow CL, Hoskinson JJ, et al. **Effect of percutaneous endoscopic gastrostomy on gastric emptying in clinically normal cats**. *Am J Vet Res* 1998; 59: 1414–1416.
221 Marks SL, Cook AK, Griffey S, et al. **Dietary modulation of methotrexate-induced enteritis in cats**. *Am J Vet Res* 1997; 58: 989–996.
222 Marks SL, Cook AK, Reader R, et al. **Effects of glutamine supplementation of an amino acid-based purified diet on intestinal mucosal integrity in cats with methotrexate-induced enteritis**. *Am J Vet Res* 1999; 60: 755–763.
223 Haney DR, Christiansen JS and Toll J. **Severe cholestatic liver disease secondary to liver fluke (*Platynosomum concinnum*) infection in three cats**. *J Am Anim Hosp Assoc* 2006; 42: 234–237.
224 Wilcox RS, Bowman DD, Barr SC, et al. **Intestinal obstruction caused by *Taenia taeniaeformis* infection in a cat**. *J Am Anim Hosp Assoc* 2009; 45: 93–96.
225 Nomura K, Koreeda T, Kawata M, et al. **Vaginal atresia with transverse septum in a cat**. *J Vet Med Sci* 1997; 59: 1045–1048.
226 Rumbeiha WK, Francis JA, Fitzgerald SD, et al. **A comprehensive study of Easter lily poisoning in cats**. *J Vet Diagn Invest* 2004; 16: 527–541.
227 Peterson ME, Kintzer PP and Hurvitz AI. **Methimazole treatment of 262 cats with hyperthyroidism**. *J Vet Intern Med* 1988; 2: 150–157.
228 Cavana P, Vittone V, Capucchio MT, et al. **Parathyroid adenocarcinoma in a nephropathic Persian cat**. *J Feline Med Surg* 2006; 8: 340–344.
229 Zatelli A, D'Ippolito P, Bonfanti U, et al. **Ultrasound-assisted drainage and alcoholization of hepatic and renal cysts: 22 cases**. *J Am Anim Hosp Assoc* 2007; 43: 112–116.
230 Litster AL and Atwell RB. **Feline heartworm disease: a clinical review**. *J Feline Med Surg* 2008; 10: 137–144.
231 Sullivan M and Yool DA. **Gastric disease in the dog and cat**. *Vet J* 1998; 156: 91–106.
232 Smith TJ, Baltzer WI, Ruaux CG, et al. **Gastric smooth muscle hamartoma in a cat**. *J Feline Med Surg* 2009; 12: 334–337.
233 Morini M, Gentilini F, Pietra M, et al. **Cytological, immunohistochemical and mutational analysis of a gastric gastrointestinal stromal tumour in a cat**. *J Comp Pathol* 2011; 145: 152–157.
234 Jerram RM, Guyer CL, Braniecki A, et al. **Endogenous lipid (cholesterol) pneumonia associated with bronchogenic carcinoma in a cat**. *J Am Anim Hosp Assoc* 1998; 34: 275–280.
235 den Hertog E, Goossens MM, van der Linde-Sipman JS, et al. **Primary hyperparathyroidism in two cats**. *Vet Q* 1997; 19: 81–84.
236 van der Gaag I, van den Ingh T, Lamers CB, et al. **Zollinger-Ellison syndrome in a cat**. *Vet Q* 1988; 10: 151–155.
237 Dole RS, MacPhail CM and Lappin MR. **Paraneoplastic leukocytosis with mature neutrophilia in a cat with pulmonary squamous cell carcinoma**. *J Feline Med Surg* 2004; 6: 391–395.
238 Anderson TE, Legendre AM and McEntee MM. **Probable hypercalcemia of malignancy in a cat with bronchogenic adenocarcinoma**. *J Am Anim Hosp Assoc* 2000; 36: 52–55.
239 Hahn KA, McEntee MF, Daniel GB, et al. **Hematologic and systemic toxicoses associated with carboplatin administration in cats**. *Am J Vet Res* 1997; 58: 677–679.
240 Ogilvie GK, Moore AS, Obradovich JE, et al. **Toxicoses and efficacy associated with administration of mitoxantrone to cats with malignant tumors**. *J Am Vet Med Assoc* 1993; 202: 1839–1844.
241 Jordan KF, Kasper CF and Schmoll HJ. **Chemotherapy-induced nausea and vomiting: current and new standards in the antiemetic prophylaxis and treatment**. *Eur J Cancer* 2005; 41: 199–205.
242 Fetting JH, McCarthy LE, Borison HL, et al. **Vomiting induced by cyclophosphamide and phosphoramide mustard in cats**. *Cancer Treat Rep* 1982; 66: 1625–1629.
243 Rassnick KM, Moore AS, Northrup NC, et al. **Phase I trial and pharmacokinetic analysis of ifosfamide in cats with sarcomas**. *Am J Vet Res* 2006; 67: 510–516.
244 Rassnick KM, Rodriguez CO, Khanna C, et al. **Results of a phase II clinical trial on the use of ifosfamide for treatment of cats with vaccine-associated sarcomas**. *Am J Vet Res* 2006; 67: 517–523.
245 O'Keefe DA, Sisson DD, Gelberg HB, et al. **Systemic toxicity associated with doxorubicin administration in cats**. *J Vet Intern Med* 1993; 7: 309–317.
246 Kristal O, Lana SE, Ogilvie GK, et al. **Single agent chemotherapy with doxorubicin for feline lymphoma: a retrospective study of 19 cases (1994–1997)**. *J Vet Intern Med* 2001; 15: 125–130.
247 Tzannes S, Hammond MF, Murphy S, et al. **Owners' perception of their cats' quality of life during COP chemotherapy for lymphoma**. *J Feline Med Surg* 2008; 10: 73–81.
248 Moore AS, Ruslander D, Cotter SM, et al. **Efficacy of, and toxicoses associated with, oral idarubicin administration in cats with neoplasia**. *J Am Vet Med Assoc* 1995; 206: 1550–1554.
249 Wilson HM. **Feline alimentary lymphoma: demystifying the enigma**. *Top Companion Anim Med* 2008; 23: 177–184.
250 Bulman-Fleming JC, Turner TR and Rosenberg MP. **Evaluation of adverse events in cats receiving long-term**

piroxicam therapy for various neoplasms. *J Feline Med Surg* 2010; 12: 262–268.
251 McCarthy LE and Borison HL. **Cisplatin-induced vomiting eliminated by ablation of the area postrema in cats**. *Cancer Treat Rep* 1984; 68: 401–404.
252 Milano S, Simon C and Grelot L. **In vitro release and tissue levels of ileal serotonin after cisplatin-induced emesis in the cat**. *Clin Auton Res* 1991; 1: 275–80.
253 Lucot JB and Crampton GH. **Buspirone blocks cisplatin-induced emesis in cats**. *J Clin Pharmacol* 1987; 27: 817–818.
254 De La Puente-Redondo VA, Tilt N, Rowan TG, et al. **Efficacy of maropitant for treatment and prevention of emesis caused by intravenous infusion of cisplatin in dogs**. *Am J Vet Res* 2007; 68: 48–56.
255 Oxford Centre for Evidence Based Medicine. Levels of evidence, http://www.cebm.net/index.aspx?o=1025 (accessed 14 April 2011).
256 Hume DZ, Solomon JA and Weisse CW. **Palliative use of a stent for colonic obstruction caused by adenocarcinoma in two cats**. *J Am Vet Med Assoc* 2006; 228: 392–396.
257 Stanley SW, Fischetti AJ and Jensen HE. **Imaging diagnosis — sublumbar pseudomycetoma in a Persian cat**. *Vet Radiol Ultrasound* 2008; 49: 176–178.
258 Campbell JA, Jutkowitz LA, Santoro KA, et al. **Continuous versus intermittent delivery of nutrition via nasoenteric feeding tubes in hospitalized canine and feline patients: 91 patients (2002–2007)**. *J Vet Emerg Crit Care (San Antonio)* 2010; 20: 232–236.
259 Glaus TM, Cornelius LM, Bartges JW, et al. **Complications with non-endoscopic percutaneous gastrostomy in 31 cats and 10 dogs: a retrospective study**. *J Small Anim Pract* 1998; 39: 218–222.
260 Radford AD, Jones PH, Gruffydd-Jones T, et al. **Unexplained outbreaks of a novel acute haemorrhagic vomiting syndrome in cats**. *Vet Rec* 2011; 169: 132–133.
261 Yuki M, Sugimoto N, Takahashi K, et al. **Enterolithiasis in a cat**. *J Feline Med Surg* 2006; 8: 349–352.
262 Minihan AC, Berg J and Evans KL. **Chronic diaphragmatic hernia in 34 dogs and 16 cats**. *J Am Anim Hosp Assoc* 2004; 40: 51–63.
263 Joseph R, Kuzi S, Lavy E, et al. **Transient megaoesophagus and oesophagitis following diaphragmatic rupture repair in a cat**. *J Feline Med Surg* 2008; 10: 284–290.
264 Owen MC, Morris PJ and Bateman RS. **Concurrent gastro-oesophageal intussusception, trichobezoar and hiatal hernia in a cat**. *N Z Vet J* 2005; 53: 371–374.
265 Formaggini L, Schmidt K and De LD. **Gastric dilatation-volvulus associated with diaphragmatic hernia in three cats: clinical presentation, surgical treatment and presumptive aetiology**. *J Feline Med Surg* 2008; 10: 198–201.
266 Lorinson D and Bright RM. **Long-term outcome of medical and surgical treatment of hiatal hernias in dogs and cats: 27 cases (1978–1996)**. *J Am Vet Med Assoc* 1998; 213: 381–384.
267 Waldron DR, Moon M, Leib MS, et al. **Oesophageal hiatal hernia in two cats**. *J Small Anim Pract* 1990; 31: 259–263.
268 Bright RM, Sackman JE, Denovo C, et al. **Hiatal hernia in the dog and cat: a retrospective study of 16 cases**. *J Small Anim Pract* 1990; 31: 244–250.
269 Prymak C, Saunders HM and Washabau RJ. **Hiatal hernia repair by restoration and stabilization of normal anatomy. An evaluation in four dogs and one cat**. *Vet Surg* 1989; 18: 386–391.
270 McConnell JF, Sparkes AH, Blunden AS, et al. **Eosinophilic fibrosing gastritis and toxoplasmosis in a cat**. *J Feline Med Surg* 2007; 9: 82–88.
271 Cecchi R, Wills SJ, Dean R, et al. **Demonstration of *Ollulanus tricuspis* in the stomach of domestic cats by biopsy**. *J Comp Pathol* 2006; 134: 374–377.
272 Gregersen P. ***Ollulanus tricuspis* (Leuckart 1865). Round worms of cats. Lungworm of cats (*Aelurostrongylus abstrusus*).** *Dansk Veterinærtidsskrift* 1994; 77: 673–674.
273 Mense MG, Gardiner CH, Moeller RB, et al. **Chronic emesis caused by a nematode-induced gastric nodule in a cat**. *J Am Vet Med Assoc* 1992; 201: 597–598.
274 Dennis R, Herrtage ME, Jefferies AR, et al. **A case of hyperplastic gastropathy in a cat**. *J Small Anim Pract* 1987; 28: 491–504.
275 Mochizuki M, Osawa N and Ishida T. **Feline coronavirus participation in diarrhea of cats**. *J Vet Med Sci* 1999; 61: 1071–1073.
276 Harvey CJ, Lopez JW and Hendrick MJ. **An uncommon intestinal manifestation of feline infectious peritonitis: 26 cases (1986–1993)**. *J Am Vet Med Assoc* 1996; 209: 1117–1120.
277 Tauni MA and Osterlund A. **Outbreak of *Salmonella typhimurium* in cats and humans associated with infection in wild birds**. *J Small Anim Pract* 2000; 41: 339–341.
278 De Cock HE, Marks SL, Stacy BA, et al. **Ileocolitis associated with Anaerobiospirillum in cats**. *J Clin Microbiol* 2004; 42: 2752–2758.
279 Peters S and Houwers DJ. **A cat with diarrhoea associated with the massive presence of *Cyniclomyces guttulatus* in the faeces**. *Tijdschr Diergeneeskd* 2009; 134: 198–199.
280 Epe C, Rehkter G, Schnieder T, et al. **Giardia in symptomatic dogs and cats in Europe – results of a European study**. *Vet Parasitol* 2010; 173: 32–38.
281 Lindsay DS, Dubey JP and Blagburn BL. **Biology of *Isospora* spp from humans, non-human primates, and domestic animals**. *Clin Microbiol Rev* 1997; 10: 19–34.
282 Kuan SY, Ticehurst K, Hoffmann KL, et al. **Intestinal strangulation after elective ovariohysterectomy**. *J Feline Med Surg* 2010; 12: 325–329.
283 Doherty D, Welsh EM and Kirby BM. **Intestinal intussusception in five postparturient queens**. *Vet Rec* 2000; 146: 614–616.
284 Cattaneo D, Colosio M, Gerboni GM, et al. **Endoscopic excision of a gastric polyp in a cat**. *Veterinaria (Cremona)* 2011; 25: 41–44.
285 Bridgeford EC, Marini RP, Feng Y, et al. **Gastric *Helicobacter* species as a cause of feline gastric lymphoma: a viable hypothesis**. *Vet Immunol Immunopathol* 2008; 123: 106–113.
286 Zikes CD, Spielman B, Shapiro W, et al. **Gastric extramedullary plasmacytoma in a cat**. *J Vet Intern Med* 1998; 12: 381–383.
287 Bortnowski HB and Rosenthal RC. **Gastrointestinal mast cell tumors and eosinophilia in two cats**. *J Am Anim Hosp Assoc* 1992; 28: 271–275.

288 Pearson H, Gaskell CJ, Gibbs C, et al. **Pyloric and oesophageal dysfunction in the cat**. *J Small Anim Pract* 1974; 487–501.

289 Baumberger A. **Pyloric dysfunction as a cause of chronic vomiting in the cat**. *Schweiz Arch Tierheilkd* 1977; 119: 415–423.

290 Wallack ST, Hornof WJ and Herrgesell EJ. **Ultrasonographic diagnosis-small bowel infarction in a cat**. *Vet Radiol Ultrasound* 2003; 44: 81–85.

291 Malik R, Pegrum S, Hoffman K, et al. **Small bowel infarction in a cat with inflammatory bowel disease**. *Aust Vet Pract* 2010; 40: 66, 68–69.

292 Shaw DH. **Gastrinoma (Zollinger-Ellison syndrome) in the dog and cat**. *Can Vet J* 1988; 29: 448–452.

293 Patnaik AK, Erlandson RA, Lieberman PH, et al. **Extra-adrenal pheochromocytoma (paraganglioma) in a cat**. *J Am Vet Med Assoc* 1990; 197: 104–106.

294 Mayhew PD and Weisse CW. **Treatment of pancreatitis-associated extrahepatic biliary tract obstruction by choledochal stenting in seven cats**. *J Small Anim Pract* 2008; 49: 133–138.

295 Lamb CR, Mason GD and Wallace MK. **Ultrasonographic diagnosis of peritoneopericardial diaphragmatic hernia in a Persian cat**. *Vet Rec* 1989; 125: 186.

296 Raflo CP and Nuernberger SP. **Abdominal mesothelioma in a cat**. *Vet Pathol* 1978; 15: 781–783.

297 Stockhaus C. **Feline necrotising pancreatitis — a retrospective study**. *Praktische Tierarzt* 2009; 90: 1131.

298 Simpson KW, Shiroma JT, Biller DS, et al. **Ante mortem diagnosis of pancreatitis in four cats**. *J Small Anim Pract* 1994; 35: 93–99.

299 Head LL, Daniel GB, Becker TJ, et al. **Use of computed tomography and radiolabeled leukocytes in a cat with pancreatitis**. *Vet Radiol Ultrasound* 2005; 46: 263–266.

300 Hines BL, Salisbury SK, Jakovljevic S, et al. **Pancreatic pseudocyst associated with chronic-active necrotizing pancreatitis in a cat**. *J Am Anim Hosp Assoc* 1996; 32: 147–152.

301 Branter EM and Viviano KR. **Multiple recurrent pancreatic cysts with associated pancreatic inflammation and atrophy in a cat**. *J Feline Med Surg* 2010; 12: 822–827.

302 Thompson KA, Parnell NK, Hohenhaus AE, et al. **Feline exocrine pancreatic insufficiency: 16 cases (1992–2007)**. *J Feline Med Surg* 2009; 11: 935–940.

303 Anderson WI and Georgi ME. **Pancreatic atrophy and fibrosis associated with *Eurytrema procyonis* in a domestic cat**. *Vet Rec* 1987; 120: 235–236.

304 Mueller MG, Ludwig LL and Barton LJ. **Use of closed-suction drains to treat generalized peritonitis in dogs and cats: 40 cases (1997–1999)**. *J Am Vet Med Assoc* 2001; 219: 789–794.

305 MacWilliams PS, Whitley N and Moore F. **Lymphadenitis and peritonitis caused by *Mycobacterium xenopi* in a cat**. *Vet Clin Pathol* 1998; 27: 50–53.

306 Sharman MJ, Goh CS, Kuipers von Lande RG, et al. **Intra-abdominal actinomycetoma in a cat**. *J Feline Med Surg* 2009; 11: 701–705.

307 Eleni C, Scaramozzino P, Busi M, et al. **Proliferative peritoneal and pleural cestodiasis in a cat caused by metacestodes of *Mesocestoides* sp Anatomohistopathological findings and genetic identification**. *Parasite* 2007; 14: 71–76.

308 Adamama-Moraitou KK, Prassinos NN, Galatos AD, et al. **Isolated abdominal fat tissue inflammation and necrosis in a cat**. *J Feline Med Surg* 2008; 10: 192–197.

309 Kyles AE, Hardie EM, Wooden BG, et al. **Clinical, clinicopathologic, radiographic, and ultrasonographic abnormalities in cats with ureteral calculi: 163 cases (1984–2002)**. *J Am Vet Med Assoc* 2005; 226: 932–936.

310 Nwadike BS, Wilson LP and Stone EA. **Use of bilateral temporary nephrostomy catheters for emergency treatment of bilateral ureter transection in a cat**. *J Am Vet Med Assoc* 2000; 217: 1862–1865.

311 Misirlioglu D, Nak D, Ozyigit MO, et al. **HER-2/neu (c-erbB-2) oncoprotein in hyperplastic endometrial polyps detected in two cats**. *J Feline Med Surg* 2009; 11: 885–888

312 Ghaffari MS, Massoudifard M, Abdi M, et al. **Uterine rupture in a cat associated with femoral hernia**. *Online J Vet Res* 2007; 11: 50–4.

313 Dejneka GJ, Klimowicz M and Nizanski W. **Some aspects of incidence of endometritis-pyometra complex in cats**. *Acta Sci Pol Medicina Veterinaria* 2005; 4: 65–70.

314 Nak D, Nak Y and Tuna B. **Follow-up examinations after medical treatment of pyometra in cats with the progesterone antagonist aglepristone**. *J Feline Med Surg* 2009; 11: 499–502.

315 Dillon AR, Brawner AR Jr, Robertson-Plouch CK, et al. **Feline heartworm disease: correlations of clinical signs, serology, and other diagnostics — results of a multicenter study**. *Vet Ther* 2000; 1: 176–182.

316 Atkins CE, DeFrancesco TC, Coats JR, et al. **Heartworm infection in cats: 50 cases (1985–1997)**. *J Am Vet Med Assoc* 2000; 217: 355–358.

317 Smith JW, Scott-Moncrieff JC and Rivers BJ. **Pneumothorax secondary to *Dirofilaria immitis* infection in two cats**. *J Am Vet Med Assoc* 1998; 213: 91–93.

318 Vilafranca M and Font A. **Thymolipoma in a cat**. *J Feline Med Surg* 2005; 7: 125–127.

319 Loser C, Lawrenz B, Werner HG, et al. **Primary lung tumours with metastasis to digits in cats**. *Kleintierpraxis* 1998; 43: 425.

320 Oberthaler KT, Mauldin E, McManus PM, et al. **Rescue therapy with doxorubicin-based chemotherapy for relapsing or refractory feline lymphoma: a retrospective study of 23 cases**. *J Feline Med Surg* 2009; 11: 259–265.

321 Shiu KB, McCartan L, Kubicek L, et al. **Intravenous administration of docetaxel to cats with cancer**. *J Vet Intern Med* 2011; 25: 916–919.

322 Jones RD, Baynes RE and Nimitz CT. **Non-steroidal anti-inflammatory drug toxicosis in dogs and cats: 240 cases (1989–1990)**. *J Am Vet Med Assoc* 1992; 201: 475–477.

323 Gunew MN, Menrath VH and Marshall RD. **Long-term safety, efficacy and palatability of oral meloxicam at 0.01–0.03 mg/kg for treatment of osteoarthritic pain in cats**. *J Feline Med Surg* 2008; 10: 235–241.

324 Erunal-Maral N, Aslan S, Findik M, et al. **Induction of abortion in queens by administration of cabergoline (Galastop) solely or in combination with the PGF2alpha analogue Alfaprostol (Gabbrostim)**. *Theriogenology* 2004; 61: 1471–1475.

325 Feldman EC, Nelson RW and Feldman MS. **Intensive 50-week evaluation of glipizide administration in 50 cats with previously untreated diabetes mellitus**. *J Am Vet Med Assoc* 1997; 210: 772–777.

326 Gaitonde BB, McCarthy LE and Borison H. **Central emetic action and toxic effects of digitalis in cats**. *J Pharmacol Exp Ther* 1964; 147: 409–416.

327 Heinrich NA, McKeever PJ and Eisenschenk MC. **Adverse events in 50 cats with allergic dermatitis receiving ciclosporin**. *Vet Dermatol* 2011; 22: 511–520.

328 Peterson ME, Greco DS and Orth DN. **Primary hypoadrenocorticism in ten cats**. *J Vet Intern Med* 1989; 3: 55–58.

329 Stonehewer J and Tasker S. **Hypoadrenocorticism in a cat**. *J Small Anim Pract* 2001; 42: 186–190.

330 Smith SA, Freeman LC and Bagladi-Swanson M. **Hypercalcemia due to latrogenic secondary hypoadrenocorticism and diabetes mellitus in a cat**. *J Am Anim Hosp Assoc* 2002; 38: 41–44.

331 Gnudi G, Bertoni G, Luppi A, et al. **Unusual hyperparathyroidism in a cat**. *Vet Radiol Ultrasound* 2001; 42: 250–253.

332 Whitney JL, Barrs VR, Wilkinson MR, et al. **Use of bisphosphonates to treat severe idiopathic hypercalcaemia in a young Ragdoll cat**. *J Feline Med Surg* 2011; 13: 129–134.

333 Barber PJ. **Disorders of the parathyroid glands**. *J Feline Med Surg* 2004; 6: 259–269.

334 Fascetti AJ and Hickman MA. **Preparturient hypocalcemia in four cats**. *J Am Vet Med Assoc* 1999; 215: 1127–1129.

335 Norman BC, Cote E and Barrett KA. **Wide-complex tachycardia associated with severe hyperkalaemia in three cats**. *J Feline Med Surg* 2006; 8: 372–378.

336 Cassutto BH and Cook LC. **An epidemiological survey of *Clostridium perfringens*-associated enterotoxemia at an army veterinary treatment facility**. *Mil Med* 2002; 167: 219–222.

337 Hohenhaus AE, Drusin LM and Garvey MS. **Serratia marcescens contamination of feline whole blood in a hospital blood bank**. *J Am Vet Med Assoc* 1997; 210: 794–798.

338 Schreiner CA and Nagode LA. **Vitamin D-dependent rickets type 2 in a four-month-old cat**. *J Am Vet Med Assoc* 2003; 222: 337–336.

339 Yuki M, Suzuki K, Sugimoto N, et al. **Two cases of feline renal cell carcinoma with secondary polycythemia**. *J Japan Vet Med Assoc* 2005; 58: 480–483.

340 Kariya K, Konno A and Ishida T. **Perforin-like immunoreactivity in four cases of lymphoma of large granular lymphocytes in the cat**. *Vet Pathol* 1997; 34: 156–159.

341 Ohshima M, Morita T, Sawada M, et al. **B-cell immunoblastic lymphoma with multinucleated giant cells in a cat**. *J Vet Med Sci* 2004; 66: 189–191.

342 Liska WD, MacEwen EG, Zaki FA, et al. **Feline systemic mastocytosis: a review and results of splenectomy in seven cases**. *J Am Anim Hosp Assoc* 1979; 15: 589–597.

343 Stockhaus C, Werner HG and Stolle A. **Systemic mastocytosis: a rare reason for chronic vomiting in a cat**. *Kleintierpraxis* 1996; 41: 767.

344 Fearnley A, Edmunds G, Sutton R, et al. **Systemic mastocytosis with mastocytaemia in a cat**. *Aust Vet Pract* 1993; 23: 194–197.

345 Crampton GH and Daunton NG. **Evidence for a motion sickness agent in cerebrospinal fluid**. *Brain Behav Evol* 1983; 23: 36–41.

346 Burke EE, Moise NS, de LA, et al. **Review of idiopathic feline vestibular syndrome in 75 cats**. *J Am Vet Med Assoc* 1985; 187: 941–943.

347 Kidder AC, Johannes C, O'Brien DP, et al. **Feline dysautonomia in the Midwestern United States: a retrospective study of nine cases**. *J Feline Med Surg* 2008; 10: 130–136.

348 Bjerkås E and Skancke E. **Feline dysautonomia in Norway**. *Vet Rec* 1994; 135: 463.

349 Wunschmann A, Garlie V, Averbeck G, et al. **Cerebral cysticercosis by *Taenia crassiceps* in a domestic cat**. *J Vet Diagn Invest* 2003; 15: 484–488.

350 Jakab CS, Gál J and Kovács RB. **Gemistocytic astrocytoma in a 7-month-old cat. Case report**. *Magy Állatorvosok Lapja* 2004; 126: 487–491.

351 Lippert AC, Faulkner JE, Evans AT, et al. **Total parenteral nutrition in clinically normal cats**. *J Am Vet Med Assoc* 1989; 194: 669–676.

352 Borison HL, McCarthy LE, Douple EB, et al. **Acute radiation-induced vomiting in area postrema-ablated cats**. *Radiat Res* 1987; 109: 430–439.

353 Hill FW and Campbell T. **Snake bite in cats**. *Aust Vet J* 1978; 54: 437–439.

354 Machado CC, Costa HLR, Lucidi CD, et al. **Clinical alterations, laboratory results and necropsy findings from a snake bite in a cat — a case report**. *Clínica Veterinária* 2006; 11: 76–80.

355 Knight TE and Kumar MS. **Lead toxicosis in cats — a review**. *J Feline Med Surg* 2003; 5: 249–255.

356 Brown CA, Jeong KS, Poppenga RH, et al. **Outbreaks of renal failure associated with melamine and cyanuric acid in dogs and cats in 2004 and 2007**. *J Vet Diagn Invest* 2007; 19: 525–531.

357 Saxon-Buri S. **Daffodil toxicosis in an adult cat**. *Can Vet J* 2004; 45: 248–250.

358 Giger U and Bucheler J. **Transfusion of type-A and type-B blood to cats**. *J Am Vet Med Assoc* 1991; 198: 411–418.

359 Washabau RJ and Holt D. **Pathogenesis, diagnosis, and therapy of feline idiopathic megacolon**. *Vet Clin North Am Small Anim Pract* 1999; 29: 589–603.

360 Hargis AM, Prieur DJ and Wescott RB. **A gastric nematode (*Ollulanus tricuspis*) in cats in the Pacific Northwest**. *J Am Vet Med Assoc* 1981; 178: 475–478.

361 el-Sanousi SM, el-Shazly MO, al-Dughyem A, et al. **An outbreak of enterotoxaemia in cats**. *Zentralbl Veterinarmed B* 1992; 39: 403–409.

362 Bacon NJ and White RA. **Extrahepatic biliary tract surgery in the cat: a case series and review**. *J Small Anim Pract* 2003; 44: 231–235.

363 Savary KC, Price GS and Vaden SL. **Hypercalcemia in cats: a retrospective study of 71 cases (1991–1997)**. *J Vet Intern Med* 2000; 14: 184–189.

364 Midkiff AM, Chew DJ, Randolph JF, et al. **Idiopathic hypercalcemia in cats**. *J Vet Intern Med* 2000; 14: 619–626.

365 Bolliger AP, Graham PA, Richard V, et al. **Detection of parathyroid hormone-related protein in cats with humoral hypercalcemia of malignancy**. *Vet Clin Pathol* 2002; 31: 3–8.

366 Baez JL, Hendrick MJ, Walker LM, et al. **Radiographic, ultrasonographic, and endoscopic findings in cats with inflammatory bowel disease of the stomach and small intestine: 33 cases (1990–1997)**. *J Am Vet Med Assoc* 1999; 215: 349–354.

367 Milner RJ, Channell CD, Levy JK, et al. **Survival times for cats with hyperthyroidism treated with iodine 131, methimazole, or both: 167 cases (1996–2003)**. *J Am Vet Med Assoc* 2006; 228: 559–563.

368 Bell R, Mellor DJ, Ramsey I, et al. **Decreased sodium:potassium ratios in cats: 49 cases**. *Vet Clin Pathol* 2005; 34: 110–114.

369 Carlin EP, Bowman DD, Scarlett JM, et al. **Prevalence of *Giardia* in symptomatic dogs and cats throughout the United States as determined by the Idexx SNAP *Giardia* test**. *Vet Ther* 2006; 7: 199–206.

370 Simpson KW, Fyfe J, Cornetta A, et al. **Subnormal concentrations of serum cobalamin (vitamin B_{12}) in cats with gastrointestinal disease**. *J Vet Intern Med* 2001; 15: 26–32.

371 Ruaux CG, Steiner JM and Williams DA. **Early biochemical and clinical responses to cobalamin supplementation in cats with signs of gastrointestinal disease and severe hypocobalaminemia**. *J Vet Intern Med* 2005; 19: 155–160.

372 Washabau RJ. **Feline acute pancreatitis — important species differences**. *J Feline Med Surg* 2001; 3: 95–98.

373 Swift NC, Marks SL, MacLachlan NJ, et al. **Evaluation of serum feline trypsin-like immunoreactivity for the diagnosis of pancreatitis in cats**. *J Am Vet Med Assoc* 2000; 217: 37–42.

374 Forman MA, Marks SL, De Cock HE, et al. **Evaluation of serum feline pancreatic lipase immunoreactivity and helical computed tomography versus conventional testing for the diagnosis of feline pancreatitis**. *J Vet Intern Med* 2004; 18: 807–815.

375 Forcada Y, German AJ, Noble PJ, et al. **Determination of serum fPLI concentrations in cats with diabetes mellitus**. *J Feline Med Surg* 2008; 10: 480–487.

376 Taeymans O, Holt N, Penninck DG, et al. **Ultrasonographic characterization of feline ileocecocolic abnormalities**. *Vet Radiol Ultrasound* 2011; 52: 335–339.

377 Gualtieri M, Monzeglio MG and Scanziani E. **Gastric neoplasia**. *Vet Clin North Am Small Anim Pract* 1999; 29: 415–440.

378 Webb CB and Trott C. **Laparoscopic diagnosis of pancreatic disease in dogs and cats**. *J Vet Intern Med* 2008; 22: 1263–1266.

379 Leib MS, Dalton MN, King SE, et al. **Endoscopic aspiration of intestinal contents in dogs and cats: 394 cases**. *J Vet Intern Med* 1999; 13: 191–193.